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Conn. Rivers and Harbors Commission
Report

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State of Connecticut
PUBLIC DOCUMENT, SPECIAL

REPORT

OF

Connecticut Rivers and Harbors Commission

TO THE

GENERAL ASSEMBLY

PRINTED BY ORDER OF THE LEGISLATURE

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C. M. Gaines, Hartford, Conn.

LETTER OF TRANSMISSION.

To the Honorable Senate, and House of Representatives, assembled:

GENTLEMEN:—

In compliance with House Joint Resolution No. 331, we herewith submit our report. This report is not signed by Mr. H. T. Parmelee of New Haven, he being in Europe for his health, hence the commission could not reach him.

EDWARD H. WARNER, Chairman, of Hartford.
OLIVER GILDERSLEEVE, of Portland.
RICHARD T. CRANE, 3d, of Bridgeport.
FRANK V. CHAPPELL, of New London.

House Joint Resolution No. 331.

STATE OF CONNECTICUT.

HOUSE OF REPRESENTATIVES.

HOUSE OF REPRESENTATIVES, February 11, 1909. Introduced by Mr. George B. Chandler of Rocky Hill, read the first time, and referred to the Committee on Roads, Bridges and Rivers.

SENATE, February 16, 1909. Read the first time and referred to the same committee.

HOUSE OF REPRESENTATIVES, April 1, 1909. The Committee on Roads, Bridges and Rivers reported through Mr. Leete of Enfield, Chairman of the Committee, on the part of the House that the resolution ought to pass.

RESOLUTION.

RAISING A COMMISSION TO INVESTIGATE AND REPORT CONCERNING THE IMPROVEMENT OF RIVERS AND HARBORS WITHIN THE STATE.

General Assembly,
January Session A. D. 1909.

RESOLVED BY THIS ASSEMBLY.

SECTION 1. That the governor be and he hereby is authorized and directed to appoint a commission consisting of five persons, to investigate the condition of the navigable rivers and harbors of the state and to report to the next General Assembly its recommendations relating to the subject and what measures can be taken for the improvement of navigation in said rivers and harbors and such legislation on the subject as said commission may deem necessary for the public interest.

SECTION 2. The comptroller is hereby authorized and directed to draw his orders on the treasurer for a sum or sums not exceeding in the aggregate the sum of twenty-five hundred dollars to pay for clerical or other assistance for the commission, and also the necessary expenses of the members of the commission in the performance of their duties, but the members of said commission shall serve without compensation.

SECTION 3. Said commission shall not make any surveys of the navigable waters of the state but shall use the surveys of said navigable waters made by the United States.

Approved, July 26, 1909.

INTRODUCTORY.

The Rivers and Harbors Commission, created primarily to investigate and report upon the condition of Connecticut waterways, and to make such recommendations as seem advisable, was not limited to the discussion of that one subject; hence, after dealing with those subjects it has been deemed advisable—after due deliberation—to append to this report a sub-report, well illustrated, dealing with the manner in which European waterways are developed, hoping to show the inadequacy of our present system in an interesting and instructive manner.

That Connecticut is bountifully endowed with water courses will at once be recognized by everyone, yet to those who have given close attention to the matter it is obvious that we little realize of what immense advantage our waterways may become, not only to our coastwise but internal commerce if intelligently improved, wisely operated and judiciously administered. Our intent is to enlighten the people of Connecticut on this tremendously important subject to the best of our ability, and as well as possible with the small means we have at hand.

While Connecticut is one of the nation's smallest states, yet her position in the manufacturing realm is one of great importance, which is conclusively shown by the value of her manufactured product which reached the enormous sum of $315,106,150 during the year 1900, thus making the state rank eighth among the states of the Union. In that year the population of Connecticut was 908,420; hence, when it is realized that the state ranks thirty-eighth in point of agriculture, we are at once face to face with the fact that we are essentially a manufacturing community; but again remembering our area to be but 4,845 square miles, we see conclusively that our destinies are to be associated with the art of creation and that the majority of our people are to draw their sustenance through the medium of the manufacturer. Therefore, in order that we shall hold the position accorded us by our industry, it is eminently fitting for us to begin to conserve our natural resources, to adopt a policy to be pursued in future years that will give us that opportunity which we shall surely need,—of maintaining our prominence as a home for manufacturers. The tremendous strides of the west and south are so plainly evidenced that detail is unnecessary; however, the coming census covering these points is bound to show a tremendous increase, hence the following figures concerning Connecticut should be of interest as bearing on our character as a manufacturing state:

	1900	1905	1910
Population,	908,420		1,114,756
*Rank in Manufacturing,	8th		
†Capital Employed,	$299,206,925	$373,283,580	
Value of Manufactured product,	315,106,150	369,082,091	
" " Agriculture,	28,276,948		
Rank in "	38th		

* Position not available 1905.

†No 1910 figures available except population.

LEADING MANUFACTURING CITIES OF THE STATE AND VALUE OF PRODUCT.

	1900	1905
Bridgeport,	$33,536,276	$44,586,519
Hartford,	23,828,961	25,973,651
New Haven,	34,899,437	39,666,118
Waterbury,	30,330,300	32,367,359
Meriden,	11,750,440	13,763,548
New Britain,	11,096,030	14,959,543

RELATIVE POSITION WITH CITIES IN THE UNITED STATES IN ORDER OF CAPITAL.

			1900	1905
Bridgeport,	31st,	Amt. cap. invested,	$31,624,974	$49,381,348*
Hartford,	34th,	" " "	28,057,265	28,358,583*
New Haven,	35th,	" " "	27,962,460	31,412,715*
Waterbury,	51st,	" " "	21,967,318	32,950,166*
Meriden,	72nd,	" " "	15,417,477	16,442,113*
New Britain,	83rd,	" " "	13,768,139	19,979,712*

*Rank not published in 1905.

While the capital invested and the manufactured product increased during the first half of the past decade yet in eight of our leading industries we decreased in rank, that is, other states equaled and passed Connecticut in these same industries. At least one large Connecticut manufacturing concern has located a plant in the west within the last few years and others contemplating such a move are known to this commission. It is obvious that these manufacturers would not seek new locations if they could market their product satisfactorily from Connecticut so as to compete with the western manufacturer who is nearer the raw material and has better shipping facilities at hand.

Having noted the changes wrought in the period used for example, is it not conclusive that the time has arrived when we must make use of the waterways with which nature has so bountifully endowed us to their fullest extent and make it possible to offer every inducement within our power to the manufacturer that is here to stay, and to induce others to come within our bounds?

HYDROGRAPHY. (Rivers.)

Connecticut has a water area of 145 square miles. It has three well-known rivers, all of which are navigable to a greater or less extent: These rivers, flowing southerly into Long Island Sound, almost divide the state into four equal parts, and from east to west are,—the Thames, Connecticut and Housatonic. The Thames is a tidal river to Norwich and has a depth of twenty feet for ten miles to Allyn's Point: (the Thames is formed by the confluence of the Yantic and Shetucket rivers whose tributary watersheds extend into Massachusetts; these streams have many developed water powers which are of great benefit to the industries in the immediate section); thence to Norwich, five miles further, the depth is fourteen feet. The river ranges from four hundred to three thousand feet in width. The commerce is principally coal, lumber, cotton, wool and steamboat freight and amounted to 497,725 tons for the year 1909, valued at $7,619,010.00.

The work done by the Federal Government on the river has reduced the cost of transportation in that it now permits vessels of sixteen to eighteen feet draft to navigate it instead of eight feet, as heretofore, and channel conditions are maintained at smaller expense owing to the absence of extreme high water, unquestionably this river is in the best condition of any of the state's waterways. It is more a tidal estuary than a river, and as it broadens out it also increases in depth. At New London, joining with the Sound, it forms a magnificent harbor which has few equals, if any, on the Atlantic coast. United States warships have passed above the railroad bridge which spans the river at the upper end of the city as far as the Navy Yard, where the Government maintains a coaling station; here the general depth of channel is twenty-six feet.

New London harbor, opening into that great natural waterway—Long Island Sound—at its eastern end is within plain view of the Atlantic, thus offering those undeveloped facilities for trans-Atlantic commerce that would be so highly prized by other countries. The largest ocean steamship that floats can come within three miles of New London at full speed and at the same time find a direct channel with sufficient draft to a landing place. Hence, if adequate docks were available, New London could lay claim to a large proportion of the world's commerce. If the city, with nature's greatest gift,—a great harbor—at its command, would instigate a campaign in conjunction with its railroads to make this harbor the beginning and ending of European travel, it would reduce the distance one hundred miles to eastern ports and obviate the slow and uncertain trip from Sandy Hook to the North river docks; it would relieve the traffic congestion in New York; it would expedite travel and be of immense benefit to the shipper. New London has connection with the Grand Trunk railway system and the New York, New Haven & Hartford, which with their through traffic relations with the Erie Railroad and Pennsylvania Railroad, virtually gives three western outlets. Thus the railroads and city alike should endeavor to make New London a future port for ocean travel instead of the often suggested Montauk Point. If New London should become a terminal port, it is declared by excellent authority that $1.00 per ton could be saved on west-bound traffic and a proportionate amount on New England points.

There are six steamboat lines now running from New London, three to New York, one to Fisher's Island, one to Sag Harbor and Greenport and one to Block Island—the latter line operates in summer only. Two of the New York lines are controlled by railroad interests.

Your commission held a hearing at New London, October 18, 1910, at which Mayor Bryan F. Mahan, Ex-Secretary of State Theodore Bodenwein, Lieut.-Col. Harry Taylor, U. S. Corps of Engineers of the War Department, Captain Thos. Hamilton, and other representative citizens appeared to discuss conditions that now obtain in that vicinity and the possibilities for betterment that could be realized if the state gave more attention to its flowing highways. The opinion of those present was that the depth of water in the harbor and the Thames river called for little or no attention other than that which the Federal authorities now give. However, every speaker brought to the attention of the commission the lack of adequate public dockage. It was stated that fifty feet was about the extent of the public landing and that this frontage is available only for small craft. There is no municipally owned dock where a vessel larger than the average launch or tender can discharge. It appears from statistics that the harbor frontage is divided as follows:

Improved frontage,	28,000 ft.
Unimproved "	4,800 "
Residential "	8,900 "

Hence, it is noted that public ownership at this important port is entirely inadequate.

Therefore, according to the mass of testimony submitted it is evident to this commission that the great need of New London is proper terminal facilities, and to gain this end those present were of the opinion that a state commission should be permanent and should act in collaboration with the municipality, in at least an advisory capacity, to bring about a better understanding between conflicting interests and to recommend a solution of the problem. The population of New London, according to the census of 1910, is 19,659, but any water terminal facilities established would directly benefit the adjacent towns, one of which (Waterford) has 3,100 population. The tonnage of New London harbor for 1909 was 707,768 tons, valued at $80,247,609.00.

Norwich and Norwich town, with a population of 28,219, at the head of navigation on the Thames river has the advantage of a fourteen-foot channel. The city, according to record, has 8,632 feet of improved river frontage and 5,000 unimproved. The improved ownership is divided as follows:

City of Norwich,	40 ft.
Norwich & N. Y. Propeller Co.,	202 "
N. Y., N. H. & H. R. R.,	2,525 "
Private,	5,865 "

Norwich has one locally owned steamboat line running daily to New York; also a boat carrying passengers, and freight as offered, running to New London, Ocean and Crescent Beaches, during the summer months. Outside of New London and Norwich there is but one other town of importance on the Thames river, that being Groton, with a population of

6,495. The Government appropriations for the Thames river have amounted to $539,600 up to January 1, 1911.

CONNECTICUT RIVER.

The Connecticut river, the state's most important stream, has the distinction of traversing two states and forming the boundary line between two other states. Having its source in Connecticut Lakes near the Canadian boundary, it drains 155 square miles of the Province of Quebec and 10,930 square miles of four New England states, an area equal to more than twice that of the entire state of Connecticut. Its length is 345 miles; therefore, at times it has an immense volume of water to take care of. This fact, alone, places it in need of attention more than any other river in the state. While the Federal Government has appropriated since the first Rivers and Harbors bill was passed by Congress, March 3, 1823, the sum of $681,170, equal to $156.58 a year a navigable mile, the state has never expended a dollar for improvement of the stream. In 1771 certain individuals desiring improvements were allowed by the "General Court" to conduct a lottery to reimburse themselves for expenditures made for dredging bars and establishing buoys. At this writing, the head of navigation is at Hartford, 49½ miles from the Sound, and a channel commonly believed to be nine feet is maintained; however, a recent report by Lieut.-Col. Harry Taylor, Corps of Engineers, U. S. A., shows that mean low water at Hartford is two feet on the gauge, hence, except under extreme conditions, eleven feet of water is available. But one steamboat line operates on the river, known as the Hartford & New York Transportation Company, and owned by the New York, New Haven & Hartford Railroad. Besides a daily boat to New York, during the open season—which is about nine months, more or less—eight tugs and twenty-two barges are employed, carrying principally cargoes of coal and lumber.

The river is a tidal stream to Hartford and varies in width from 600 feet to 1,250 feet. It not only forms a source of revenue for commercial purposes but its undeveloped resources, from a pleasure standpoint, have not been realized. It offers to the vacationist an ideal resort and the possibilities for the development of the adjacent territory are unlimited. Its banks at many points are in need of immediate attention, and as they are without the jurisdiction of the Federal Government, the state should take care of them in an adequate manner. There is ample opportunity and need for permanent improvement which the state and United States Government could co-operate in if Connecticut had a permanent Rivers and Harbors Commission. The tonnage of the river, carried principally by the Hartford & New York Transportation Company, amounted to 614,789 tons, valued at $27,162,737.00. There are two cities and a large number of towns served by the river, several having no rail connection, thus a long haul is required to freight terminals during the closed season.

Middletown, with a population of 20,749, is 32 miles from the mouth of the river. At this city the river front is owned as follows:

Improved		*Unimproved*
State of Connecticut,	170 ft.	Various ownership, 42,475
Railroad,	985 "	
Transportation Co.,	1,455 "	
City of Mdtn. Foot of Green St.	35 "	
" " " " " College St.	28 "	
Mdtn. Electric Light Co.,	100 "	
Middletown Yacht Club,	132 "	
Private ownership,	1,600 "	
	4,505 ft.	

There is no municipal dock. The city is a railroad junction point; hence, if proper terminal facilities were available, a number of manufacturing communities would be directly benefitted.

Hartford is the largest city on the river, having a population of 98,915. At the last session of the General Assembly its charter was amended, allowing the city to build and maintain public docks, and giving the right of eminent domain for ten years. The city has not exercised that right but has acquired, through lease, a modern concrete dock of two levels with a warehouse attached. A number of cargoes of coal, sand and lumber discharged at this dock in 1910, during the short season remaining after the lease became effective. If proper handling devices were arranged, the dock would increase its usefulness materially. A railroad runs within 150 feet of the dock and a trolley line within a quarter of a mile. Again, if provision was made for proper interchange of traffic and rail connection were realized immense advantage would accrue to the shippers of the city and its environments.

Through the efforts of various waterway associations in the valley, and the commercial organizations, provision was made in the River and Harbor bill passed March 3, 1909, for a comprehensive survey of the river to Hartford. This report, recently completed, recommends an increase in channel depth to twelve feet, at a cost of about $27,000; many improvements to the channel at the worst bars by building dikes and revetments to cost $100,000; and also calls for a 300 feet wide channel, 15 feet deep, across the bar at the mouth of the river in place of the 12 feet 200 feet wide channel now existing.

The Hartford dike has been raised by the Government during the last two seasons to ten feet above mean low water. Since this improvement was made, the amount of dredging necessary on Hartford upper and lower bars has decreased 50 per cent., which is a great saving to the Government and aid to navigation. The river front at Hartford approximates 32,590 feet, or 6.17 miles improved and unimproved, and divided as follows:

Improved		*Unimproved*	
City of Hartford "Parks",	4,950 ft.	North meadows, various owners,	10,900
" " " Water Dept.,	820 "	City of Hartford,	2,100
Conn. River Bridge and Highway District,	1,730 "	South meadows, various owners,	8,810
N. Y., N. H. & H. R. R., Hartford & N. Y. Trans. Co., Connecticut Co., Gas Co. leased,	2,520 "		21,810
Hartford Electric Light Co.,	390 "		
Colt's Patent Fire Arms Co., leased to city for dock,	300 "		
Asa J. & T. B. Farwell,	70 "		
	10,780 ft.		

There is an excellent opportunity for both Hartford and East Hartford to reclaim great acreages of land that now floods at high water, and make the same available for factory sites. It would undoubtedly pay well for these communities to acquire this meadow land, systematically reclaiming it by pumping sand from the river-bed and giving the land to manufacturers as an inducement to locate in the vicinity.

A hearing was held by your commissioners at Hartford on December 15th, at which representatives of various organizations were present from Middletown, South Glastonbury, Wethersfield, Hartford, Windsor, East Windsor, Windsor Locks and Suffield. This hearing was of considerable length and a large amount of information, which is of value, was collected. The speakers pointed out the inadequacy of the buoying and lighting, the damage being done at various places by washing of the banks, the forming of bars on account of the washing, the scant depth of channel, which precludes the use of the river by the coasters which are built larger than years ago, and the inadequacy of public docking facilities and proper terminals. The destruction of banks by every recurring freshet, and the demand for better terminals were the subjects most dwelt upon. Hopes were freely expressed that some method might be solved for getting more attention paid to the needs of the people of the valley, which might be done if there was a commission to appeal to for assistance.

Above Hartford the river is not navigable except for small pleasure craft; however, to demonstrate the possibilities of navigation, Springfield interests have carried several cargoes of coal on barges, handling about 65 tons each, to that city in the last year or two. From Hartford to Windsor Locks—13 miles—the bottom is shifting; from there to the present Enfield dam—5 miles—it is solid rock, and from the dam, which is an old affair, to Holyoke there is a fixed bottom with a channel depth of about 7 feet. This section of the river has received $130,000 from the Federal Government, of which $8,786.56 was carried to surplus in 1907 and

1909. No appropriation for improvements has been made since 1880. The amounts voted in 1902 and 1907 were for surveys.

The banks of the river above Hartford, particularly on the east shore, are badly in need of attention. This condition is apparent to a marked degree just north of the Midland Division bridge of the N. Y., N. H. & H. R. R. in the East Hartford meadows and continues a menace to property at intervals on both sides until the rocky section of the river is reached. Remembering the fact that the river does not carry a heavy load of silt, except during freshets and that at low water the banks are not in jeopardy, indicates that the damage is done at high water periods. The great masses of alluvial soil and the hundreds of cubic yards of subsoil that are carried down stream at such times, not only decrease land ownership at one place but add to it at other places where it is usually less available for agricultural or commercial purposes. It also fills the channels, impedes navigation, and costs thousands of dollars to remove from the river's lower reaches annually. These conditions can be largely obviated by proper treatment of the banks which, being beneficial to all concerned, would make it appear that if the state is to improve conditions, the towns interested should contribute to the improvements. The Harbor and Land Commissioners of Massachusetts have spent a large sum on the banks of the river at Agawam and through the Northampton-Hadley meadows. The chief of engineers of the War Department has recommended the expenditure of $1,105,600 to construct a 7 foot channel, 100 feet wide, from Hartford to Windsor Locks under the following conditions:

> "1. That a suitable lock and dam for surmounting Enfield Rapids be constructed by private or corporate interests, free of cost to the United States.
>
> 2. That navigation through said lock shall be free from any toll or charge.
>
> 3. That those constructing the lock and dam assume all responsibility for claims for damages that may arise from flowage rights, from injury to water power, or from any other source.
>
> 4. That after construction the lock shall become the property of the United States, and shall be maintained and operated at the expense of the Federal Government."

A syndicate stands ready to accept these conditions and construct the lock and dam which will develop approximately 20,000 H. P. providing it can get federal authority which has been impossible, owing to the fact that the owners of the present works which were commenced in 1824 and which in the opinion of this commission have not kept pace with requirements—the locks at present being apparently inadequate and it is reported they decline to sell their franchise—wish also to construct a dam, they having received authority from the state to do so by amendment to their charter in the legislature of 1909. While these two companies are contending for the right to dam the river at Windsor Locks the Government refuses to act, at least until such time as the differences are adjusted.

This condition of affairs holds in abeyance the probable completion of an immense concrete dam, at least 38 feet high, with locks that will be adequate to handle future up-river navigation and to be modelled in accordance with those on the New York State Barge Canal (Erie Canal) so that barges loading at lake ports could pass up the Connecticut to Springfield, Chicopee and Holyoke. The development of the latent horse power would make available power that could be purchased by manufacturers in the valley, thus being a great boon to its future progress. Making possible navigation on the river above Hartford cannot but be a forerunner of a wonderful industrial growth benefitting the whole valley. The project should not be longer delayed.

In connection with the use of this and other water power privileges, an annual tax per horse power has been suggested, to be fixed by the Federal Government. Your commission believes that any tax of this nature should accrue to the state and not to the Federal Government. At present it is provided by the charter of the Connecticut River Company that the Governor shall appoint a Board of Commissioners, consisting of three members, under whose direction the necessary canals shall be laid out, etc. This commission has power to assess damages done individuals by canal or other works. If the company holding this charter eventually receives federal right to construct a new dam, this provision of their charter would still be effective. However, for the best interests of the people, a commission with state authority should have supervision in connection with the Government officials over such an important project.

A great deal has been said about the possibility of navigation above Hartford,—some feel that it can never be accomplished. It is, however, entirely feasible and the combining of power development with navigation is a happy solution. Let every citizen of Connecticut realize that the people of Massachusetts have a just claim to the use of the Connecticut river which they have been denied so many years and that what is beneficial to them is bound to be to us, and so on to New England and the nation.

HOUSATONIC RIVER.

This river rises in a series of lakes in the vicinity of Pittsfield, Massachusetts, and like other Connecticut streams is largely used for water power purposes. At the mouth of the river the Government has constructed a jetty 915 feet long. Its chief tributary is the Naugatuck river which is noted for its great extremes of water. Its bed is rocky and strewn with boulders and is not used for navigation. The Housatonic is navigable to Derby and Shelton, where the Naugatuck has its juncture. The general channel depth to Derby is from 5½ to 6½ feet but on account of the crooked channel commerce is usually carried by tidal navigation, barges going up stream on flood-tide. There has been $297,450 expended on the river since the first appropriation in 1871 by the Government. Even with the unsatisfactory condition, commerce to the extent of 81,485 tons was handled last year, valued at $472,088.76. If plans were devised for pooling or canalizing the Naugatuck river to Waterbury the Housatonic would become an important stream and the Government would be more inclined to recognize it as such.

OTHER RIVERS.

The Pawcatuck, Quinnipiac, Mill, West, Pequonnock, Saugatuck, and Five Mile rivers, all flowing into Long Island Sound, are navigable to some extent. These rivers have received some attention from the Government.

HARBORS.

We have dealt with New London harbor in connection with the Thames river.

New Haven harbor, with its tributary rivers, constitutes the state's most important harbor because it handles yearly the greatest amount of commerce. For the calendar year 1909 the tonnage amounted to 2,019,198 tons, valued at $101,005,336.65. This is 902,067 tons larger and $61,513,708 greater than the state's next largest port, viz.: Bridgeport. As provided by nature, this harbor was not one of refuge in southerly or southeasterly storms; hence, to make it a safe anchorage for passing craft as well as providing for its own commerce, it has been necessary to construct a breakwater of three sections across the wide mouth of the harbor. This breakwater, which is 3,603 feet long, is not entirely finished, it having a projected length of 597 feet yet to be built; yet in 1909 a total of 5,670 vessels found shelter behind it. By an act of June 25, 1910, $100,000 additional was appropriated by the Government toward its completion, it being estimated that $35,000 more will fully complete it. This will bring the cost of this project to $1,264,000 which has entirely been expended by the Government. The main channel to the docks is 20 feet and there are ample 15 feet and 20 feet anchorage basins for present requirements. There is a 9 foot channel in the West river to the plants of the Howard Company and the Sanderson Fertilizer Company, which was dredged by them at their expense but is now being widened by the Government. There is a 12 foot channel in the Quinnipiac to Tomlinson's bridge, which serves a large number of shippers. There is a fixed bridge on Mill river which makes it impossible for a number of concerns above to get the results that would accrue should it be made a drawbridge, and it is the opinion of your commission that some way should be found to accomplish what the affected manufacturers desire. The harbor frontage of the city, following the harbor lines established by the Federal Government, below the bridges is approximately 45,815 feet, or 8.64 miles. This frontage is divided as follows:

Improved,	9,250	ft.	various	ownership
Unimproved,	4,050	"	"	"
Park,	5,700	"	city	"
City Wharf,	375	"	"	"
City (Mfg. property)	650	"	"	"
Railroad frontage,	25,790	"	railroad	"
	45,815	"		

There is additional frontage for commercial purposes in the rivers. Long Wharf has been abandoned, there being a submerged wreck at the end of the wharf inside of the harbor line. Canal Wharf is obsolete and little used. The city has a public dock, 375 feet frontage, approached by Hamilton Street. It has also acquired a manufacturing property adjacent to it which gives area enough for further development. Here, as in other cities, no provision has been made for discharging machinery, nor has the trolley track been extended to the dock from Water Street which is close at hand. If rail facilities were established as well as proper hoisting machinery, then the dock would be of greater service to the shipper and cars could be hauled from the dock to the various factories. Consignees now pay demurrage, awaiting a berth at private docks, in order to take advantage of the discharging machinery.

At a meeting of your commission held October 11, 1910, in the City Hall, attended by Mayor Frank J. Rice, Harbor Master Edgar S. Dowe, Secretary Julin of the Chamber of Commerce, Mr. E. E. Durant of the Geo. F. Warner Mfg. Co., and Messrs. Martin, Weaver and Gagel of the Board of Harbor Commissioners—without going into detail—the consensus of opinion of those present was that the harbor was in good condition and that after the improvements projected on the harbor and breakwater were finished by the Government, New Haven would have as good a harbor as required for some time to come. It was believed that public dockage should be increased and that proper handling devices should be installed on the city wharf. Most of those present also believed that trolley connection would be very beneficial to all.

BRIDGEPORT HARBOR.

This harbor is about seventeen miles west of New Haven and four miles west of the mouth of the Housatonic river. The harbor, as constituted, contains the area between Stratford Point and Fairfield reef, Black Rock harbor (two and a quarter miles to the west but now considered a part of the Harbor proper), Johnson's river, Yellow Mill pond and Pequonnock river. The city, essentially a manufacturing community, has increased in population from 70,996 in 1900 to 102,054 in 1910, taking rank as Connecticut's second largest city. Its proximity to New York and the great activity of its commercial bodies in behalf of the city are largely responsible for this growth. The tonnage of the harbor and its branches has made an excellent increase in the last two calendar years, for which statistics are available as shown below:

1908—Total Tonnage,	890,895	Value,	$37,572,196.20
1909— " "	1,117,131	"	39,491,627.82

The amount of appropriations for harbor improvements up to June 25, 1910, amounted to $1,021,400. Through this expenditure and when contracts in force are completed, a 22-foot anchorage basin (which is also a harbor of refuge for craft bound for other ports), will be acquired, also a 12-foot basin about 600,000 square feet in extent, an 18-foot main channel, an 18-foot channel up Pequonnock river to the J. A. Black Coal Company's dock, and deepening the channel in Black Rock harbor from nine to twelve feet as well as the completion of the breakwaters. This will give Bridgeport an adequate harbor for some time to come, except, perhaps, that a deeper channel might be advisable in Black Rock harbor; but the same questions of frontage ownership and terminal facilities appear here as elsewhere.

A hearing was held by your commission on September 16, 1910, in Bridgeport, at which the following were present:

HON. EDW. T. BUCKINGHAM, Mayor of Bridgeport.
CHAS. H. MORRIS, Harbor Master, Bridgeport.
H. M. BEERS, Harbor Master, Stratford.
R. W. MILLER, Traffic Manager of Crane Co.
GARRY PADDOCK, Alderman, Bridgeport.
L. W. WILSON, of "Bridgeport Farmer."

It was brought out that the only dock front owned by the city is at the foot of Wall Street and is about 48 feet wide, which makes it almost useless for commercial purposes. This, the city's only public dock, has no hoisting apparatus nor is it connected by rail lines. It was stated that the railroad owned or controlled the more central or valuable portion of the harbor and that its ownership approximated 6,060 feet.

The question of the establishment of proper terminal facilities seemed to be of supreme importance to the city and any assistance a commission could give the city in accomplishing the desired result would be hailed with delight. A question concerning removal of mud which seemed to be a riparian matter, was brought up as a point for consideration.

OTHER HARBORS.

Duck Island Harbor—between New Haven and the mouth of the Connecticut river—had $60,000 appropriated for prosecuting work on the breakwater in March, 1910, and upon which $190,000 has been authorized and $100,000 is contained in Rivers and Harbors bill now before United States Senate, which will total $350,000, completing the project and giving a harbor of refuge that will be of great value. Last year in its incompleted state, eight hundred vessels took advantage of its shelter.

Norwalk Harbor has had $202,413 expended for improvements and maintenance. Its total tonnage was 222,787 in 1909, valued at $2,320,577.73.

Stamford Harbor has had expended $180,260.53, tonnage, 1909, 264,615, valued at $10,522,311.45.

Greenwich, Southport and Five Mile River harbors have all received Government attention and have a considerable amount of commerce.

STONINGTON HARBOR.

This harbor was at one time the terminal of the Stonington line of steamers, now discontinued. It is little used at present time; however the Government has expended a total of $337,453.83, and facilities for a vastly increased commerce are easily available. The port is an important factor in the fishing industry.

MYSTIC HARBOR.

This harbor and river have had $36,600 expended upon them by the Government. There is considerable shipbuilding at Mystic and Noank.

BRANFORD HARBOR.

This harbor has three divisions, known as the outer harbor, inner harbor, and the river which flows in from the northeast. The maximum draft at present is seven feet at mean low water. The mean tide is 6.5 feet, thus giving 13.5 at flood-tide. The harbor has had $15,000 expended upon it by the Government. Its tonnage for 1909 was 40,880 tons, valued at $269,772.80. A private corporation and the town have made some changes in the harbor that have been beneficial to navigation.

MILFORD HARBOR.

West of New Haven about nine miles, this harbor has a draft of nine feet over the outer bar up to Merwin's wharf and from that point to about five hundred feet above the town dock there is six feet of water. Improvements made have benefitted shipping to a considerable extent. The last figures available show that in 1908 the tonnage was 28,587 tons, valued at $411,533.22.

From the foregoing part of this report it will be noted that much has been done for Connecticut's waterways by the National Government, an expenditure, roughly estimated, at $5,000,000 having been made for all time. While this amount may seem large, it shrinks into insignificance when compared with other sections. The entire water-borne tonnage of Connecticut amounted to 5,796,591 tons in 1909, a gain of 433,666 tons over the previous year. The value of this tonnage reached the enormous total of $289,142,678.10, a gain of $82,500,000 over 1908. This is only a faint reminder of the importance of the work our waterways are now doing and gives us a slight idea of the great wealth and prosperity to be added to our already thriving state by building well for the future. Let us look for a moment at the Government appropriation for the Mississippi and its tributaries, amounting to about one-third of the entire $600,000,000 appropriated by the United States for all its rivers and harbors while the commerce of the system—excluding the Ohio—amounted to about 4,500,000 tons, or a million tons less than that of the state of Connecticut alone.

OTHER STATES

The last few years have witnessed a tremendous awakening to the possibilities of the nation's 26,226 miles of navigable rivers and to the development of the harbors upon our coasts. This movement has created a widespread interest in what can be attained in the United States by the proper development of our natural waterways and has led to the projection of many plans of magnitude, some of which are in embryo and others are near fulfilment. Many states have provided for commissions to investigate conditions as Connecticut has done, but the movement has not been of long enough standing to allow the various states to enact legislation which would be a sufficient guide to follow; hence, it is for Connecticut, in a degree, to be first in laying a foundation for a code of laws covering its waterways that will be a model for other states to follow.

The State of New York is at present constructing a barge canal with a draft of twelve feet from Waterford on the Hudson to Tonawanda on the Niagara. For this immense undertaking, the state has appropriated $101,000,000. Up to December 1, 1910, seventy-one contracts have been let for various sections, aggregating $67,639,651, and a total of $25,167,084 worth of work has been completed. These contracts were estimated to cost $69,537,176 in 1903; hence, notwithstanding the increased cost of labor and material, a saving of nearly $2,000,000 has been made for the state by the "Department of the State Engineer and Surveyor". An interesting matter to note in regard to this great work, is the fact that to date on all claims filed in connection with barge canal improvements, aggregating $4,955,715, awards only of $418,525 or 8.4 per cent. have been allowed by the courts. There is also under construction a canal, known as the Oswego Canal, from Syracuse to Lake Ontario, and another, the Champlain Canal, from Waterford on the Hudson to Whitehall on Lake Champlain. It is expected that the Champlain Canal will be ready for use in the spring of 1913 and the combined Oswego and Erie Canals from Oswego to Troy will be in operation in the spring of 1914 and to Buffalo by the spring of 1915. The State of New York has also authorized the extension to the south of the Cayuga and Seneca Canal at a cost of $9,000,000.

The completion of these canals is bound to facilitate the movement of bulk freight and greatly reduce the cost of transportation. It will be possible for a 1,000-ton barge to load at any Connecticut port where twelve feet of water is available, and reach cities along the Mohawk valley, on the Great Lakes, the St. Lawrence river and Lake Champlain.

Illinois has appropriated $20,000,000 for a canal across the state from Lake Michigan to the Mississippi.

New Jersey, through its Inland Waterways Commission, is building a canal from Cape May to Bay Head, to cost $300,000, and is asking for an appropriation at the present session of the legislature to purchase a right of way across the state for a ship canal 25 feet deep, from the Raritan Bay to the Delaware river. The building of this thirty-one mile canal would save one hundred and eighty-four miles over the present route by water between New York and Philadelphia, and allow the transportation of freight in a class of vessels of much cheaper construction, also reduce the insurance about two-thirds.

Nearer home, we find that the state of Rhode Island has recently appropriated $500,000 for the improvement of Narragansett Bay and Providence river. The Government has duplicated the amount and Providence has augmented it by $250,000 for improvements to its terminal facilities. Pawtucket has also voted $60,000 to improve the Blackstone river, making a total of $1,310,000 for waterways in that progressive state.

At present, the Board of Engineers of the War Department are seeking facts concerning the advisability of building a canal around Point Judith, and a private corporation has a ship canal from Buzzard's Bay to Cape Cod Bay 25% completed. The latter project will not only be of immense advantage to commerce but will be, from a humane standpoint, the greatest improvement ever attained on the Atlantic coast. On Cape Cod's barren reaches, one thousand wrecks have occurred since 1880, millions of dollars worth of property has gone to pieces, and many a brave sailor has found a watery grave. As recently as January 10, 1911, seventeen seamen perished in a fifty-mile gale on Peaked Hill bars, all of which sacrifice of life would have been avoided if the Cape Cod Canal was finished.

Massachusetts has a Board of Harbor and Land Commissioners who have wide and varied powers. This commission has been in existence a number of years and has been a great factor in the improvement of the state's waterways. Boston Harbor has been the chief object of attention and at present the state, through this commission, is to reclaim two thousand acres of flats and build new piers at an expense of $5,000,000. The Commonwealth flats are a notable example of the commission's activities. During 1910, the state leased to the New York, New Haven & Hartford Railroad a large dock, built upon reclaimed lands, netting the state 3½% on the investment.

RECOMMENDATIONS.

1. We recommend the creation of the office of a "State Engineer" to be filled by a graduate civil engineer, who shall have general supervision over any and all changes or betterments that may be projected or carried out to its rivers or harbors by the State, with sufficient authority to enable him to successfully discharge the duties of his office. (This commission suggests that such "State Engineer" might also have direct supervision of the construction and maintenance of roads, bridges or any other engineering work that the State may require).

2. We recommend a permanent Rivers and Harbors Commission to consist of three persons, to be appointed by the Governor, and that the State Engineer shall work in conjunction with said Commission on all matters pertaining to rivers and harbors in this State. Said Commission should also have authority to direct the rivers and harbors work of the Engineer.

3. The Commission should be invested with State authority to consult with the proper Federal authorities regarding government expenditures on the waterways of the State whenever necessity demands.

4. The Commission should have authority to direct the State Engineer to survey such routes for canals in connection with navigable waters as may seem feasible, and to prepare estimates of cost as directed, but the Commission shall have no authority to construct any canals but shall report their findings with recommendations to the legislature.

5. The Commission should confer with the municipalities and towns located on waterways in the State in regard to water terminal facilities; to bring about if possible better facilities for the exchange of freight between rail and water, also to expedite the final distribution of such freight; and shall also promote in every possible way the establishment of proper discharging facilities on municipal docks.

6. The Commission recommends that a municipality or town that desires to establish public wharves, shall have the right to condemn waterfront property for such purpose.

7. The Commission recommends that a suitable office be provided in the Capitol building which might also be the office of the State Engineer, where all records, maps, etc., may be preserved subject to the inspection of the public.

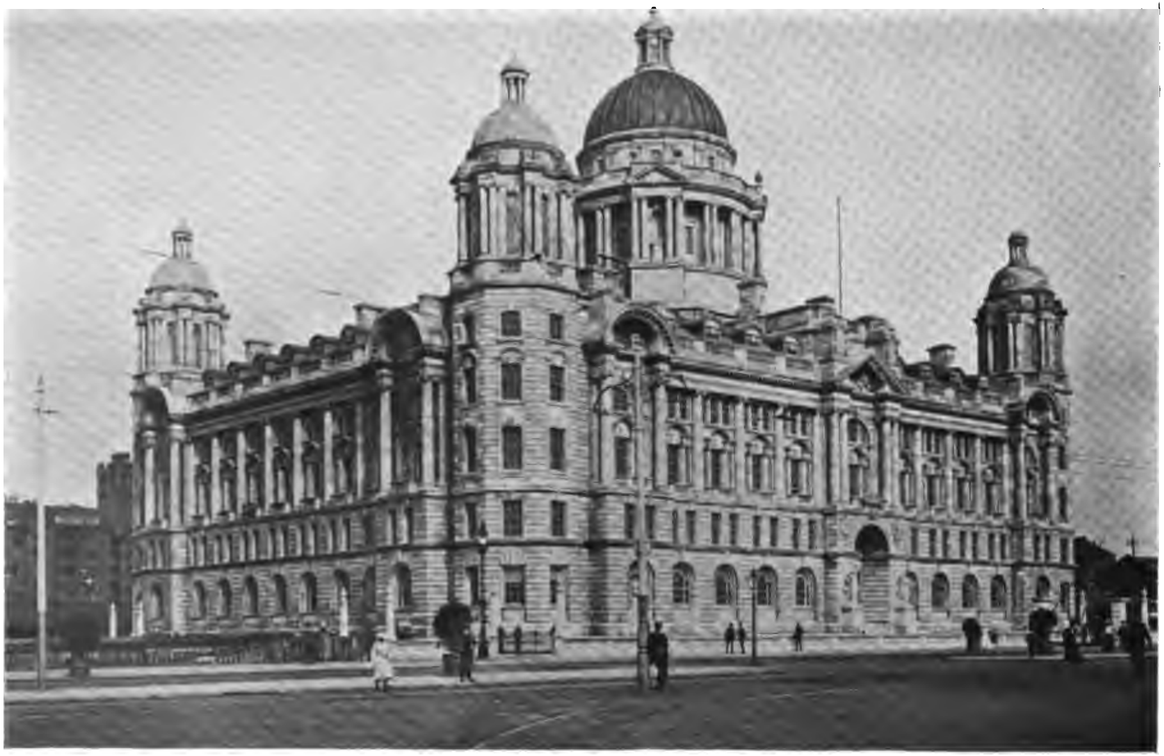
PART II.

A Study of Some Representative European Ports in the summer of 1909

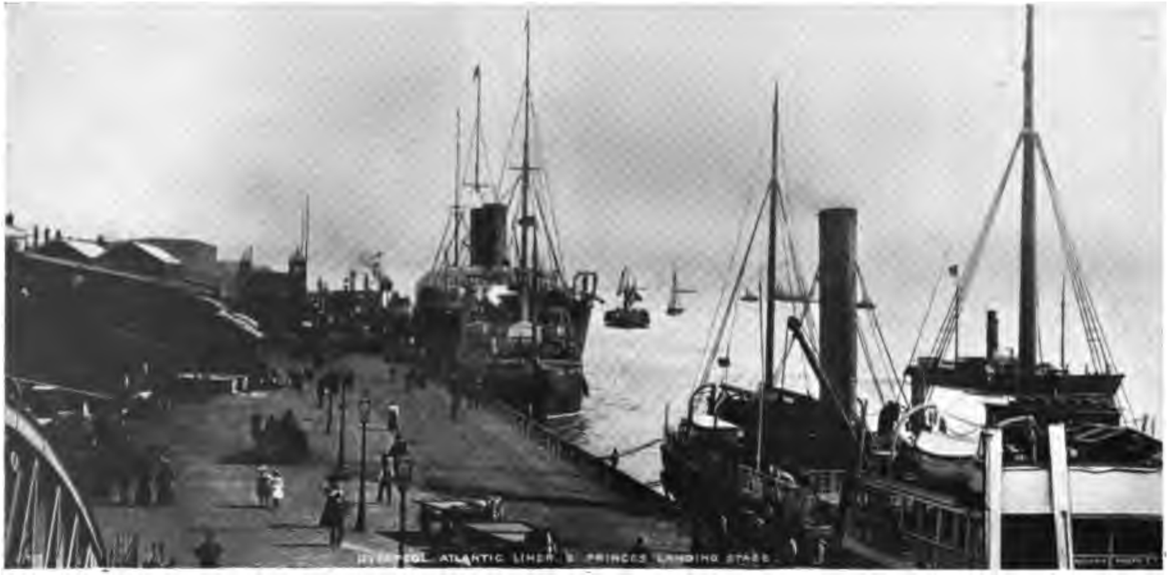
BY

FREDERICK L. FORD

City Engineer, Hartford, Conn.



THE "WHITE PALACE."
The Magnificent New Office Building of the "Mersey Docks and Harbour Board."



THE "PRINCES LANDING STAGE."

THE PORT OF LIVERPOOL.

When one crosses the Atlantic and arrives at the "Princes Landing Stage" at Liverpool, he at once realizes that he has reached one of the world's greatest ports. Up and down the River Mersey as far as the eye can reach is one unbroken system of quays, docks and basins, carefully planned, well constructed, and equipped with the latest and best mechanical appliances. From the opposite side of the ship can be seen another portion of this great dock system on the Birkenhead side of the River Mersey. And from the ship there also looms up what is locally known as the "White Palace", the office building and headquarters of the "Mersey Docks and Harbour Board", the Parliamentary Trust which so ably manages this great Port and Trust.

The "Princes Landing Stage" is so unusual to Americans that a brief description of its construction and uses seems important. At Liverpool there is a range in extreme spring tides in the Mersey River of about 33 feet, and because of this great variation it became necessary to construct some device for loading and unloading passengers and freight at varying tide levels.

The Landing Stage constructed for this purpose is 2,478 feet long by 80 feet wide, and is connected with the shore by eight bridges with swivel joints at each end and heavy mooring chains fastened near the base of the quay. This large floating structure is supported by about 200 iron pontoons, each about 80 feet long, 10 feet wide and 6 feet deep. The deck of the Landing Stage is from six to eight feet above the water level, and lowering and movable gangways are used to reach the decks of the various sized vessels by easy inclines from the small ferry boats plying up and down and across the Mersey, to the largest ocean liners arriving at and departing from Liverpool. One of the bridges connecting the Landing Stage with the shore is 550 feet in length and 35 feet in width. It is used for highway purposes as well as for pedestrians, and is so constructed that at extreme low water the grade is 1 in 20; and at other stages of the river, less inclined or wholly level.

The northerly end of "The Princes Landing Stage" is used annually by about 6,000 ocean-going and coastwise vessels. These arrive at and depart from the port at any stage of the tide. The central portion opposite the floating bridge is used for goods traffic across the Mersey River, and the southerly portion, about 800 feet in length, is appropriated for passenger ferry service, and is used by over twenty-eight million people each year. Mechanical conveyors are provided and used to handle luggage between steamers, railway trains, and other conveyances.

"The Princes Jetty", a fixed pile structure about 350 feet long has been constructed at the northerly end of the Princes Landing Stage for landing cattle and goods at all stages of the tide. Adjoining this is a commodious wharf with pens for cattle.

On the shore opposite the Landing Stage is the Riverside Railway Station, a commodious and convenient structure for the arrival and departure of London passengers. Special four-hour trains are run between Liverpool and London connecting with inbound and outbound ocean-going steamers.

At present the docks and basins consist of 427 acres of water area and 26 miles of lineal quayage on the Liverpool side of the Mersey River, and 165 acres of water area and 9 miles of lineal quayage on the Birkenhead side, making a total water area of 592 acres, and a total lineal quayage of 36 miles.

The area of the Dock Estate consists of 1,171 acres on the Liverpool side, and 506 on the Birkenhead side, or a total of 1,677 acres. On the Liverpool side the docks extend from the Hornby Dock on the north to the Herculaneum Dock on the south, a distance of over seven miles, with not a foot of property between these limits owned by any individual or other corporation, and beyond these limits the Mersey Dock Estate owns large areas of foreshore property for future extensions of this great system.

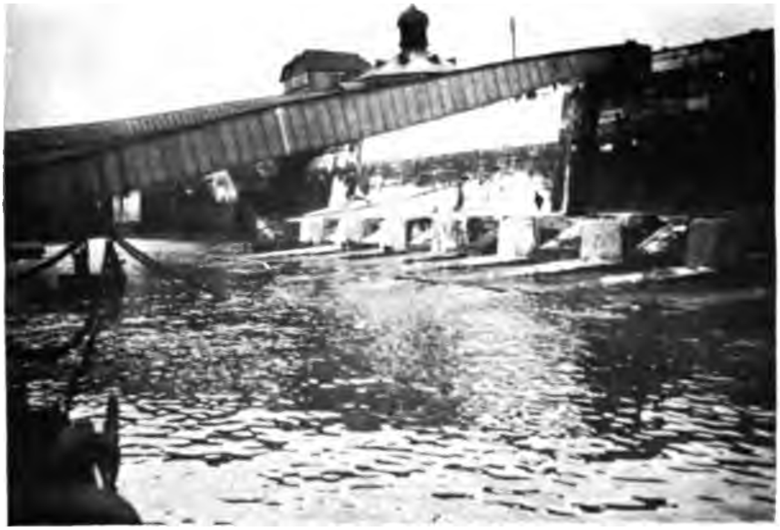
The total cost of the great Liverpool Dock System has been over $150,000,000, and the yearly maintenance cost is between eight and nine million dollars. The board has power to issue bonds from time to time, the amount authorized to date being $154,770,282. Bonds have been issued at rates of from 4⅜, to as low as 2½ per cent., and money borrowed to the extent of $122,483,552, leaving a balance of borrowing power on July 1, 1909, of $32,286,754.

The Board's revenue which amounts to about $10,000,000 annually is derived chiefly from rates received on vessels, dues on goods, and warehouse charges. As there are no dividends to be paid, the income is used wholly for the maintenance of the high standard of the system and for future extensions; and when this becomes more than sufficient for such purposes, the rates are lowered accordingly.

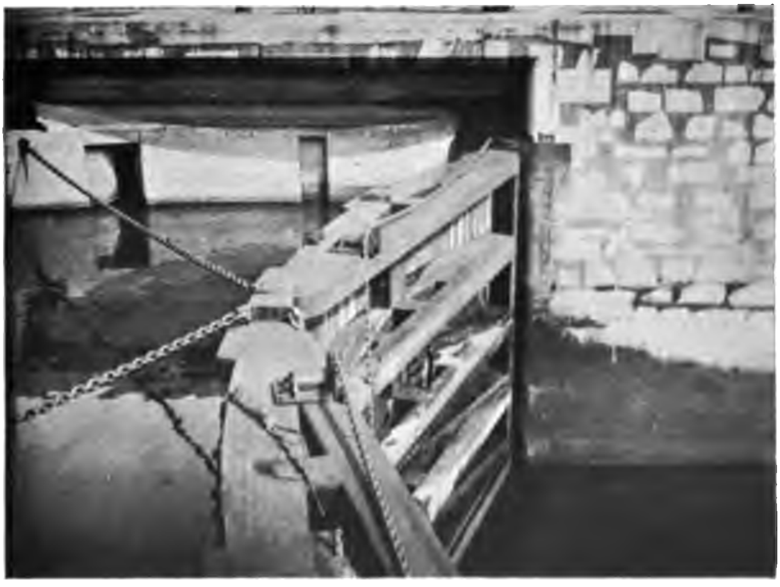
The growth of the Port of Liverpool is well illustrated by the following decade statistics since 1858:

Year	Vessels	Tonnage	Total Dues
1858	21,352	4,441,943	$1,994,111
1868	20,218	5,497,924	3,238,821
1878	18,841	7,029,082	4,473,596
1888	22,241	9,017,935	4,544,980
1898	24,664	11,815,376	5,022,076
1908	25,739	17,111,814	6,412,007

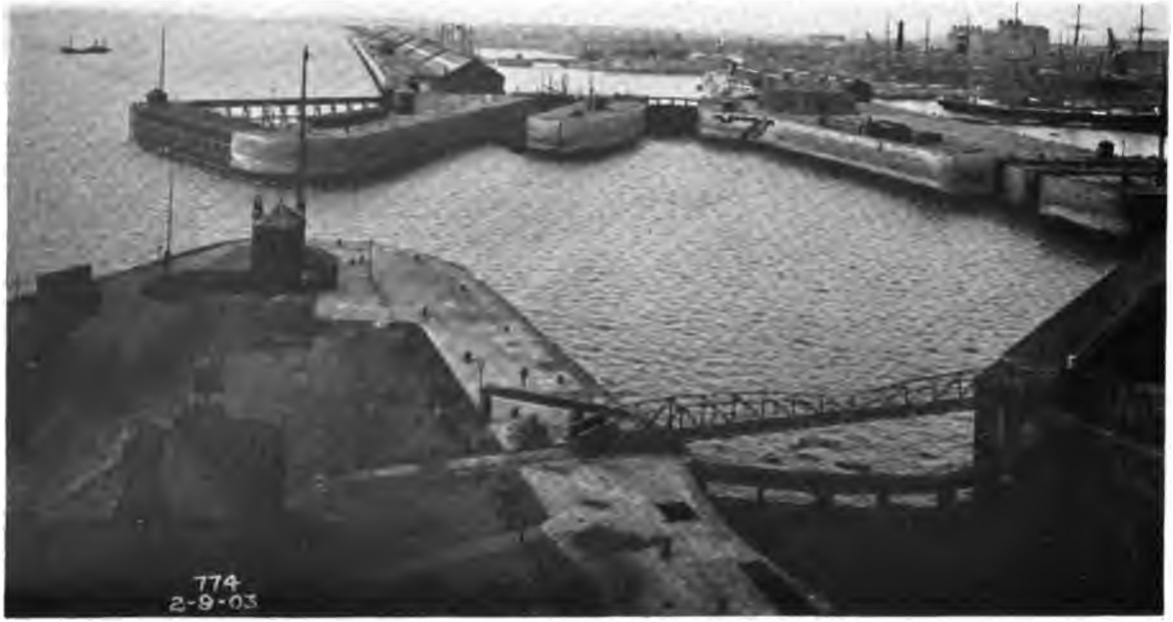
The docks on the Liverpool side are constructed both parallel with and at right angles to the Mersey. They extend back from the shore line for distances varying from 800 to over 2,000 feet, ending near a marginal elevated railway, from the trains of which can be obtained a splendid general view of the ceaseless activity of this mammoth under-



Movable Bridges and Mooring Chains Fastening the "Princes Landing Stage" to the Quay. View at Low Water.



Massive Gate and Lock at Entrance to One of the Great Docks. Note Difference of 15 or 20 feet in Level of Water Inside and Outside of Gate.

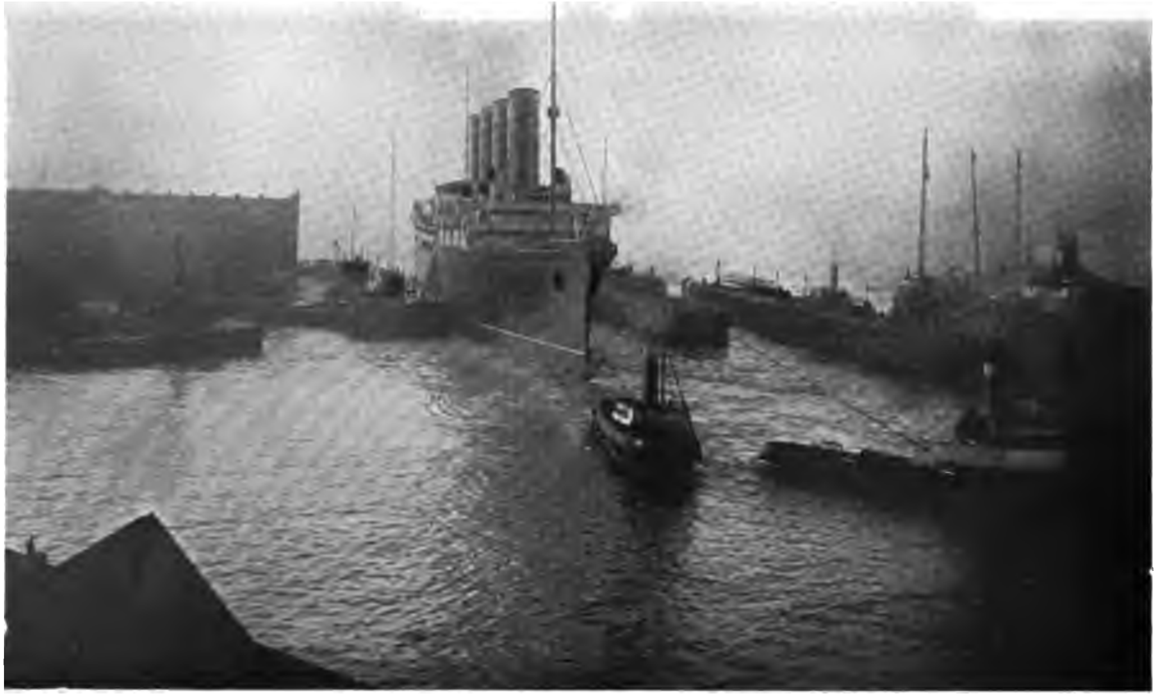


Birdseye View of Liverpool Docks from Canada Tower Looking North.

Sand Pump Dredger "Coronation" at Work in the River Mersey.

This dredger is a twin-screw steamer of a speed of 10 knots per hour, and a capacity of 70,000 cubic feet. The "Coronation" is capable of handling 3,500 tons in 50 minutes from a depth of sixty-five feet.

"Carmania" of the Cunard Line in Canada Graving Dock.



R. M. S. "Mauretania" of the Cunard Line, the Largest Ocean-going Steamer in the World, passing through Sandon Half-tide Dock Entrance.

taking. Underneath the elevated railway there is a dock railway on the quay level.

In the entire system there are sixty-three wet docks, nineteen dry docks, and four basins. All of the docks are enclosed by heavily constructed locks and gates to maintain a constant depth of water, while the basins are unprotected by gates, and the water in them rises and falls with the tides. Of the docks, twelve on the Liverpool, and two on the Birkenhead side of the Mersey have water areas equal to or greater than ten acres, the largest being the Canada Dock with a water area of twenty-four acres. Thirteen of the docks have a lineal quayage of over 3,000 feet, the largest again being the Canada Dock with over 4,000 feet. There are also eighteen dry docks at Liverpool and three at Birkenhead, with a total floor length of 12,575 feet.

The Liverpool docks and quays are equipped with every conceivable mechanical appliance for handling business expeditiously and economically. On the Liverpool side of the Mersey there are two hundred and sixteen hydraulic cranes and jiggers lifting from one to one hundred tons each; sixteen steam cranes, twelve of which are movable roof cranes with a maximum capacity of fifteen tons; and twenty-five hand cranes lifting from one to twenty-five tons each.

On the Birkenhead side there are seventeen hydraulic, steam, and hand-power cranes, lifting from one to twenty-seven tons each.

The Langton Graving Dock is equipped with a movable hydraulic crane capable of lifting thirty tons in any of the four chambers of the dock. In addition there are four floating barge cranes—The "Hercules", The "Samson", The "Atlas", and the "Titan", capable of lifting respectively, 50, 30, 30 and 25 tons each. These cranes are continually in demand in the heavy dock and river work in and around Liverpool.

All of the marine work of the Port of Liverpool is carried on by the Mersey Docks and Harbour Board, the following equipment being utilized for the purpose; five sand pump dredges, fourteen ladder or grab dredges, sixteen steam hopper barges, two steam tugs, two survey steamers, two steam launches, thirteen lightships and watch vessels, twenty-six barges, four steam pilot vessels, making eighty-four vessels in all. A twin-screw self-propelling sand pump hopper dredger, "The Leviathan", (the largest in the world) has recently been built for the Board. This dredger cost about $750,000 and is capable of dredging 10,000 tons of sand every fifty minutes in a maximum depth of seventy feet of water. The dimensions of the dredger are,—length over all 479 feet, breadth 69 feet, draught 23 feet, and speed, when loaded, 10 knots per hour.

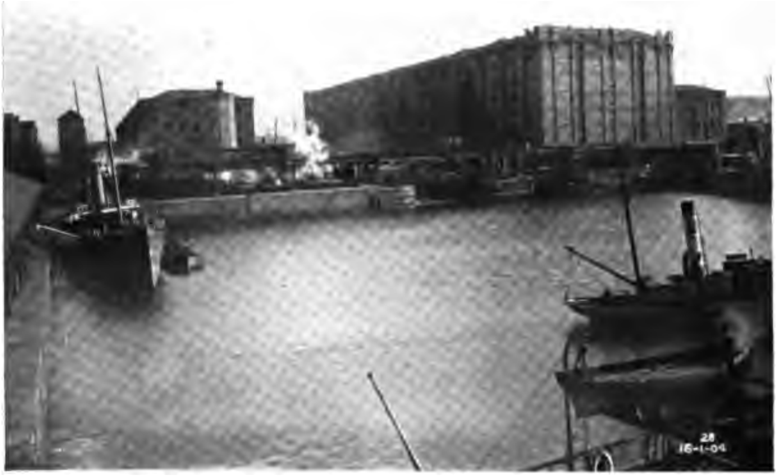
The Mersey Board has charge of the pilotage, lighting, and buoying of the channel. For this purpose there are nine lighthouses, built between 1830 and 1908, equipped with the most up-to-date electric, or gas dioptric lights, both fixed and flashing, which can be seen for distances varying from three to twenty-four nautical miles. There are also five light-ships equipped with lights visible for ten nautical miles, and fog signals. Gas lights on buoys are arranged at seven different locations in the various channels, with lights visible for three or four miles. Fire, telegraph, telephone, and semaphone stations are also maintained.

The Mersey Docks and Harbour Board does an enormous storehousing business, special warehouses being provided for the principal classes of goods as follows:

Opened	Warehouses	No. of Floors	Quay Frontage
1846-7	Albert Dock Warehouses	Vaults, quay, ½ deck & 4 floors above	2,169 lin. ft.
1854-5	Stanley Dock Warehouses	Vaults, quays & 4 floors above	633 lin. ft.
1856	Wapping Dock Warehouses	Vaults, quays & 4 floors above	753 lin. ft.
1858	Birkenhead Dock Warehouses,	Vaults, quays & 1 floor above	518 lin. ft.
1875 *	Morpeth Dock Warehouses,	Vaults, quays & 3 floors above	166 lin. ft.
1867-8	Waterloo Grain Warehouses,	Quay & 5 floors above	1,385 lin. ft.
1868-9	Birkenhead Grain Warehouses,	Quay & 5 floors above	2,176 lin. ft.
1869	Composite Warehouses,	Quay, close shed & 4 floors above	276 lin. ft.
1877 *	Wallasey Dock Warehouses,	Quay, close shed & 2 floors above	1,200 lin. ft.
1896	Wool Warehouse Gt. Howard St.	Vaults & 2 floors above	—— lin. ft.
1900	Stanley Dock Tobacco Warehouse	Vaults, quay 12 floors above	625 lin. ft.
	Total,		9,901 lin. ft.

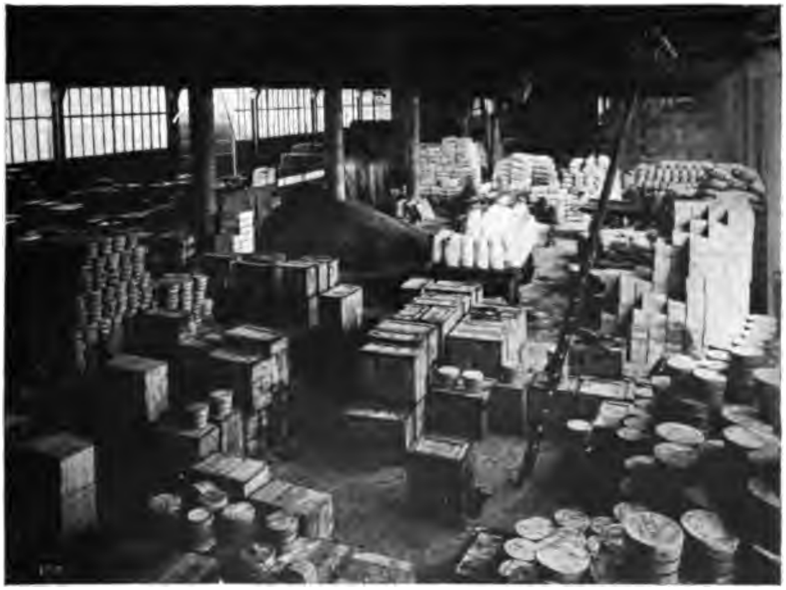
*The whole of the Morpeth Warehouses and Blocks B & C of the Wallasey Warehouses now form part of the Birkenhead Foreign Animals Wharf and are not available for general traffic.

At the Wellington, Canada, Bramley-Moore, and Herculaneum Docks on the Lancashire side, and the east and west floats on the Birkenhead side, every facility, even to floating elevators, has been provided for adequately handling the coal trade. Two cases taken from the Liverpool hand-book well illustrate the facilities for the rapid handling of cargoes and clearing the quays at the Liverpool Docks. " 'The Lake Champlain' arrived in Liverpool on a certain Sunday, and in forty-eight hours had discharged 12,000 tons measurement of cargo, and sailed again the following Wednesday morning with 2,000 tons of coal and cargo, and a large contingent of troops".

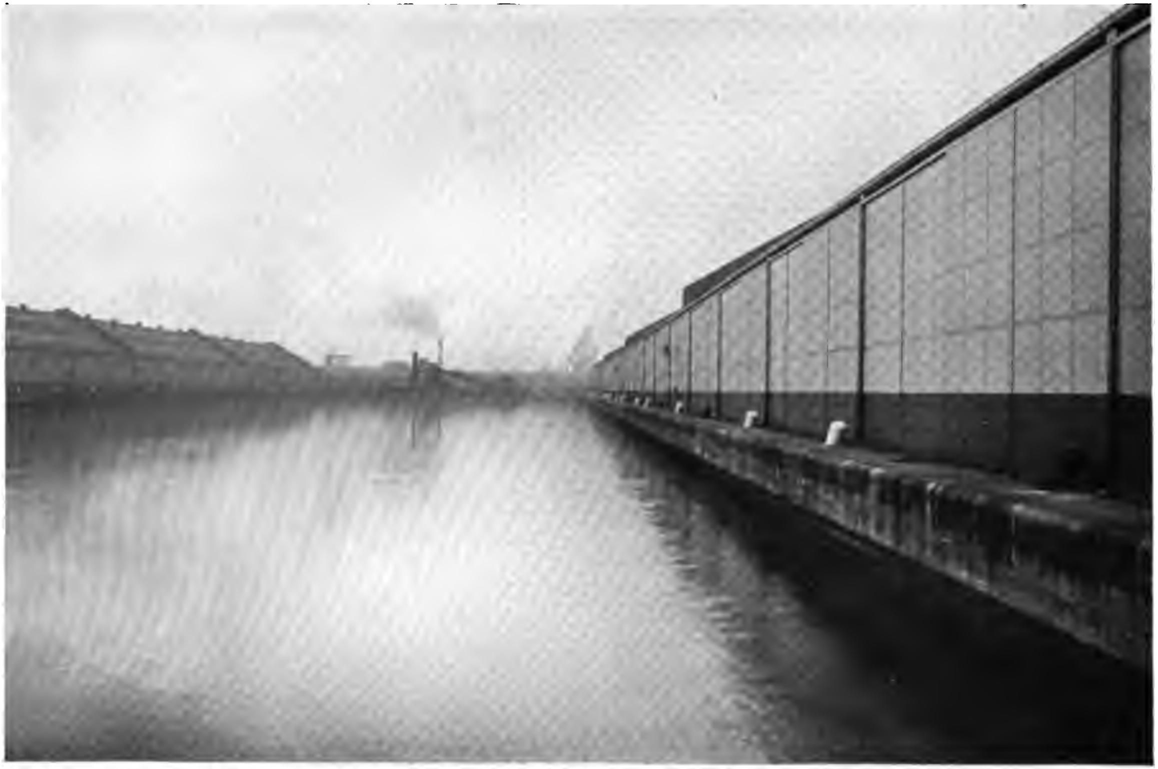


New Stanley Dock Tobacco Warehouse.

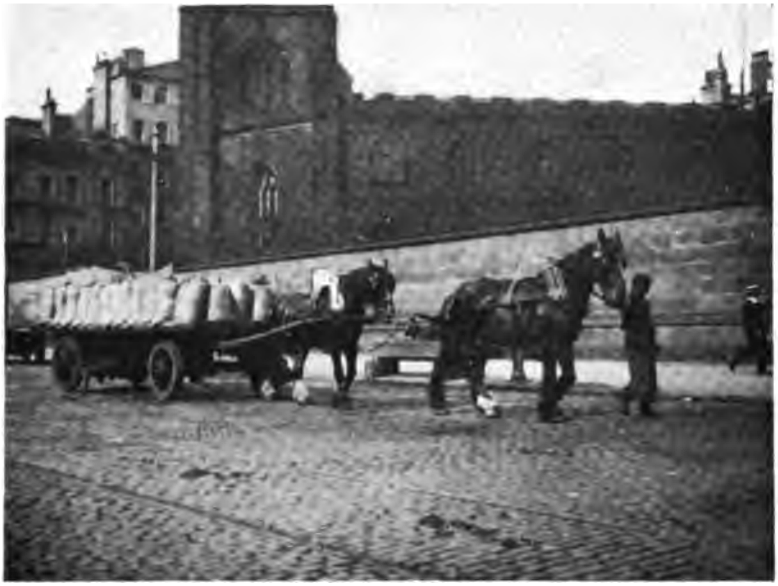
This warehouse contains 12 floors each having an area of three acres. The storage capacity is about 55,000 casks of tobacco.



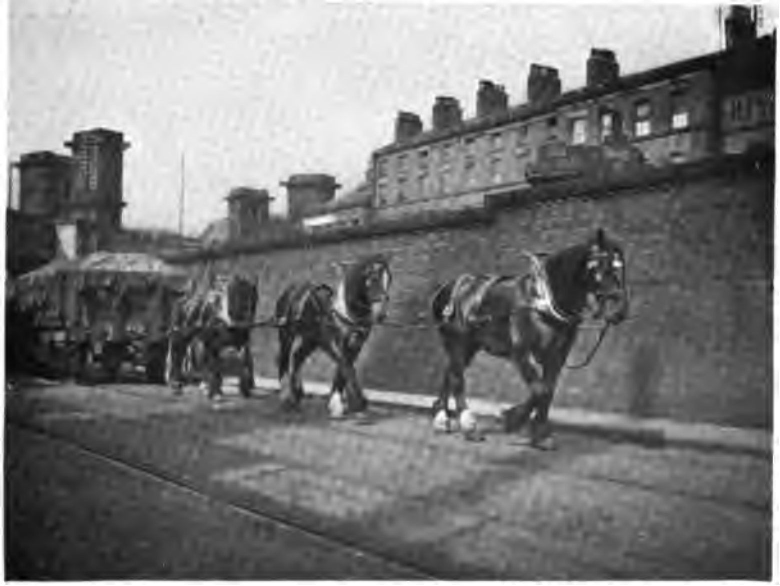
Ground Floor of a Double Story Shed Showing Inward Cargo.



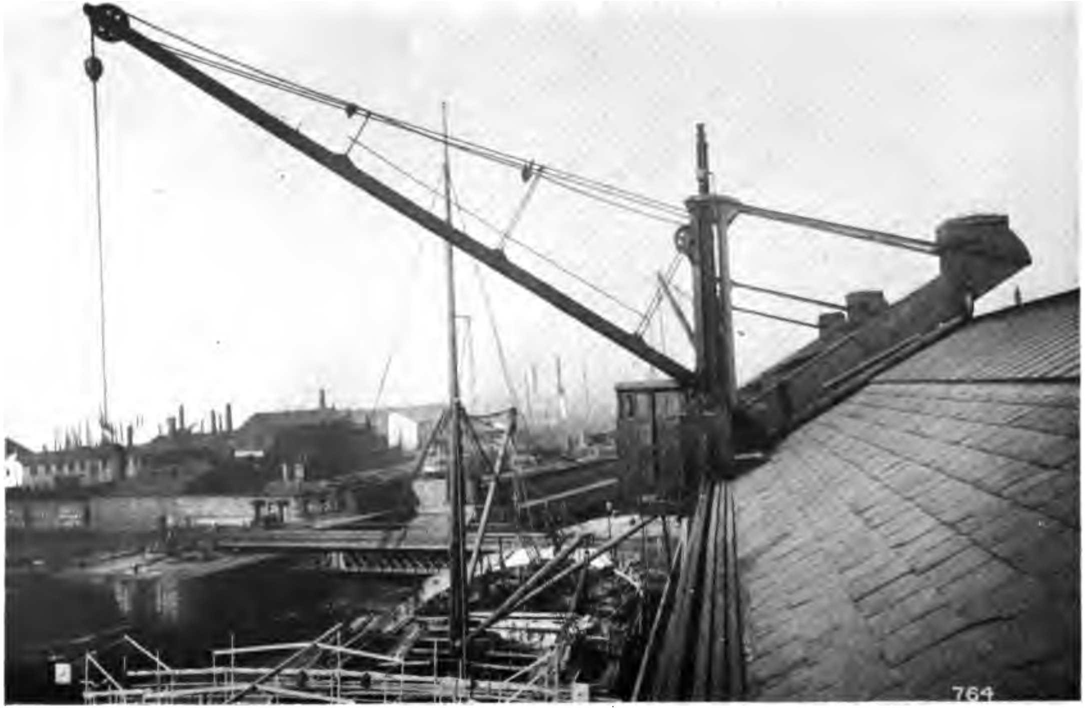
View Showing One of the New Docks with Modern Fireproof Sheds on Edge of Quays.



Two-Horse Tandem Hitch Transporting Goods from Docks to Warehouses. These horses are said to haul loads of 12 tons per horse over the Liverpool pavements.



Three-Horse Tandem Hitch Hauling a Loaded Freight Car Around the Liverpool Docks.



Traveling Roof Crane with a Maximum Capacity of 15 Tons.

"The S. S. 'Irada' from Galveston, with 30,026 bales of cotton, 640 tons of wheat, and 2,800 bags of flour, commenced to discharge at 1 P. M. on the 5th of November, 1900, and finished at 10 P. M. on the 9th of that month, the working time being sixty hours. The steamer took in about 2,500 tons of bunker coal, and sailed again at noon on the 10th of November, 1900. Nearly the whole of the cotton was weighed as landed, and removed by the consignees within three days."

The new Stanley Dock Warehouse for the storage of tobacco is one of the largest storehouses in the world. It is 723 feet long, 165 feet wide and 13 stories (about 125 feet) high. It is of fireproof construction being built of brick and steel with concrete floors. Over 27,000,000 brick and 6,000 tons of iron were used in its construction. It has a capacity of over 60,000 casks of tobacco in single tier without piling. The Mersey Board also maintains a Lairage (foreign animals wharf) at Birkenhead, with a ground area of over 900,000 square feet and a capacity of 6,172 oxen and 16,000 sheep. Connected with this wharf are slaughter-house accommodations for over 6,000 head of cattle and sheep, and chilling rooms for handling about 3,000 carcasses per day.

While the Mersey Dock Estate possesses over eighty miles of railway track around the great docks, it is interesting to note that over 90 per cent. of the traffic of the port is handled to and from the ships and warehouses in horse-drawn drays or "lurries". From early morning till late at night there is one continuous procession of these four-wheeled, heavily laden drays travelling along the border highway of the great estate. The platform bodies project over the wheels, giving a large loading surface. The horses are powerful beasts, and are usually hitched up in tandem style with from one to three horses to each dray. It is said that some of these powerful Clyde horses draw loads of ten tons each, over the Liverpool pavements. This requires, especially on the heavy traffic streets, surfaces which are hard and durable with low tractive resistance and good foothold for the horses. Most of the pavements on such streets are of granite or the famous Liverpool stone sets (small cubes of granite or whinstone from three to six inches square on each surface).

After studying the great docks of Liverpool, which, as a system, stand without a rival, and noting how skilfully and smoothly they are run, one naturally wants to learn something about the Trust which so successfully manages them for the benefit of the public.

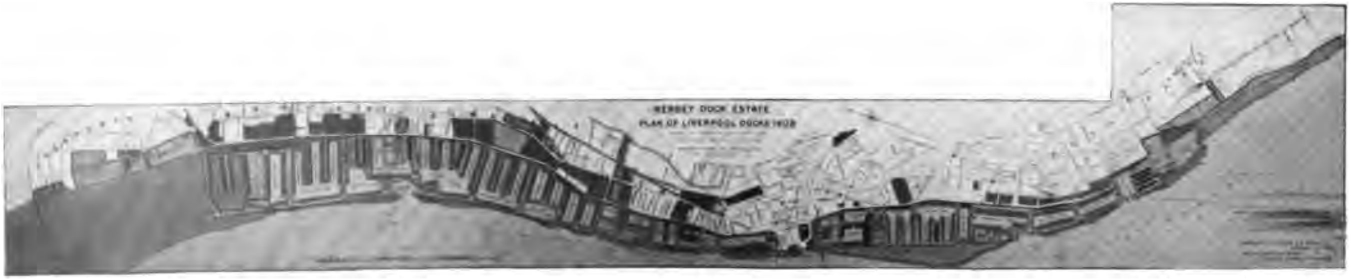
Prior to 1857 the Liverpool Docks were managed by the Liverpool Corporation, and the docks on the Birkenhead side by a private company later purchased by the City of Liverpool. By an act of Parliament passed in 1857, the ownership and management of all the docks and works connected therewith on both sides of the Mersey River became vested in a public trust known as "The Mersey Docks and Harbour Board." This Board consists of twenty-eight members, twenty-four of whom are elected by the Dock Ratepayers (persons paying rates and dues on ships and goods), and the remaining four are appointed by the Mersey Conservancy Commissioners consisting of the First Lord of the Admirality, the Chancellor of the Duchy of Lancaster, and the President of the Board of

Trade. The members of the Board are men of the highest character and attainments, and serve without compensation. The Board with its large staff of officials and employees is now housed in a magnificent new office building located near the Princes Landing Stage. The central portion of the building is octagonal in shape, and on the panels between the first and second floors is the following inscription which those who have crossed the Atlantic for the first time can fully appreciate.

Anno Domini MCMVII
They that go down
To the sea in ships
And do business
In great waters
These see the works
Of the Lord and His
Wonders in the deep.

Powerful Hoisting Crane Putting Coal in Steamship.

Floating Barge Crane "Hercules" with a Maximum Lifting Capacity of 50 Tons.



Plan of Liverpool Docks in 1909. Birkenhead Docks on Opposite Side of Mersey River not Shown.

THE PORT OF GLASGOW.

It is said that Glasgow made the Clyde, and the Clyde then made Glasgow. When one considers that in 1830, almost within memory of the present generation, navigation on the Clyde was hardly worth considering, the tonnage being but a little over seven hundred thousand, and that today the number of sailing and steam vessels in and out of Glasgow per year is over thirty-four thousand, with a tonnage of over twelve millions; and that the population of Glasgow has grown to over 600,000, one begins to realize what a tremendous influence a well-developed navigable river has upon the destiny of a city.

The great task of transforming and developing nearly twenty miles of the Clyde, from a narrow, shallow, tortuous stream, to a great navigable waterway has been, and still is, in charge of a board known as "The Trustees of the Clyde Navigation", constituted from 1809 to date, as follows:

Prior to 1809,—The Magistrates and City Council of Glasgow.

1809—1825,	—The Lord Provost, Magistrates, and Council of the City of Glasgow as separate Statutory Trustees.	
1825—1840,	—The Lord Provost, Magistrates, and Council of the City of Glasgow, and five other persons interested in the trade of the River and Firth of Clyde, nominated and appointed by them.	
1840—1858,	—The Lord Provost of the City of Glasgow .	1
	The Five Bailies	5
	The Dean of Guild	1
	The Deacon Convener	1
	Members of the Town Council . . .	15
	The Chairman of the Chamber of Commerce .	1
	Named by the Merchant's House . . .	3
	Named by the Trade's House	2
	Named by the Bailies and Birleymen of the Barony of Gorbals	2
	Named by the Magistrates and Council of the Burg of Calton	1
	Named by the Magistrates and Council of the Burg of Anderson	1
		33
1858—1905,	—The Lord Provost of Glasgow	1
	Town Councillors of Glasgow chosen by the Town Council	9
	Representatives of the shipping, mercantile, and trading interests of Glasgow, viz.:	
	Chosen by the Chamber of Commerce . .	2
	Chosen by Merchant's House	2
	Chosen by Trade's House	2
	Elected by Ship-owners and Rate payers . .	9
		25

1905, —Chosen by the Corporation of the City of Glasgow	10
Chosen by the County Council of Lanark	2
Chosen by the County Council of Dumbarton	1
Chosen by the Town Council of Govan	1
Chosen by the Town Council of Patrick	1
Chosen by the Town Council of Dumbarton	1
Chosen by the Town Council of Renfrew	1
Chosen by the Town Council of Clydebank	1
Chosen by the Chamber of Commerce	2
Chosen by the Merchant's House	2
Chosen by the Trade's House	2
Elected by the Rate-payer Electors	18
	42

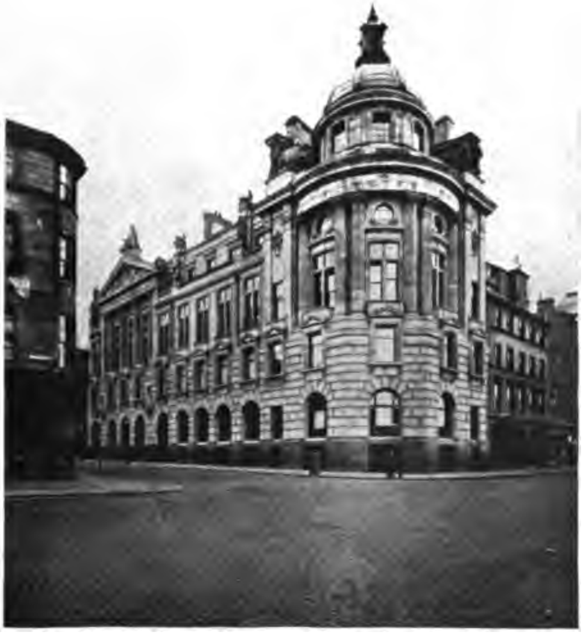
The detailed work of "The Trustees of the Clyde Navigation" is carried out through the following eleven standing committees and a large force of administrative officials and employees: (1) Management; (2) Law and Parliamentary Bills; (3) Finance; (4) Superannuation fund; (5) New works and maintenance of Harbor and River; (6) Workshops and mechanical appliances; (7) Harbor and graving docks; (8) Traffic and storage, (9) Ferries; (10) Rates; and (11) Stores.

The work of the Trustees as described by one of their officials, is principally:

(1) Works
  (a) The deepening and straightening of the river together with the buoying and lighting thereof
  (b) The continuation of riverside quayage, tidal basins, and graving docks, along with the equipment of the harbor with sheds, cranes and other appliances and tramways.
  (c) The maintenance of the whole undertaking.
(2) Borrowing of money.
  The borrowing of money for capital purposes. The amount authorized by the Act of 1858, including all previous money authorized to be borrowed, was $7,309,440, and it has been increased till it is now over $34,000,000.
(3) Rating.
  The levying of dues on all vessels and goods, and for the use of the various appliances, all within prescribed limits.

The most remarkable feature of the development of the Clyde, after the undertaking was transferred from the municipality to the Parliamentary Trustees under the Act of 1809, is the fact that Clyde navigation has been financed wholly on its own credit without either Government or Municipal assistance. While over $34,000,000 has been expended upon this great project, only about four-fifths of this amount has been borrowed.

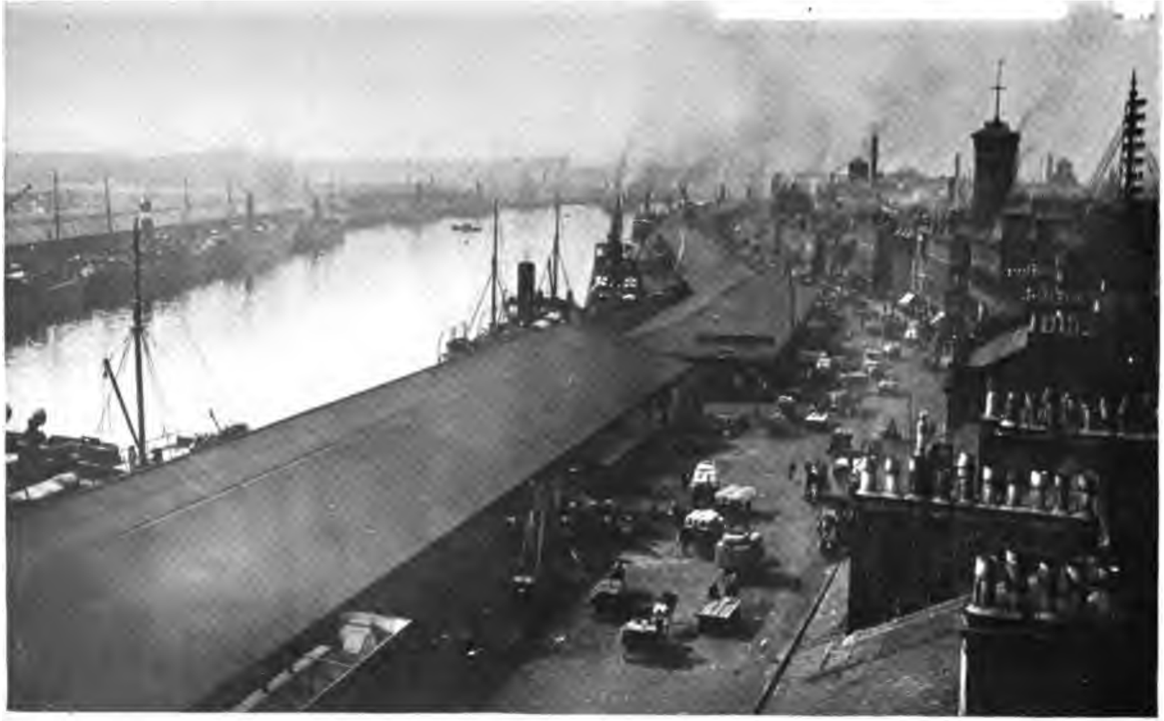
The progress in trade and the increase in revenue from $16,130 in 1880 to over $2,430,000 at present has given the investing public abundant confidence to furnish sufficient capital as needed to finance the great undertaking.



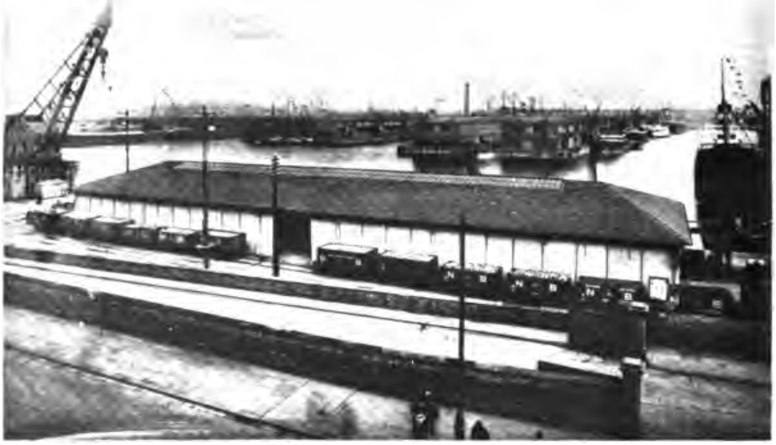
Clyde Navigation Trust Chambers.

Dredger Working in Glasgow Harbour.

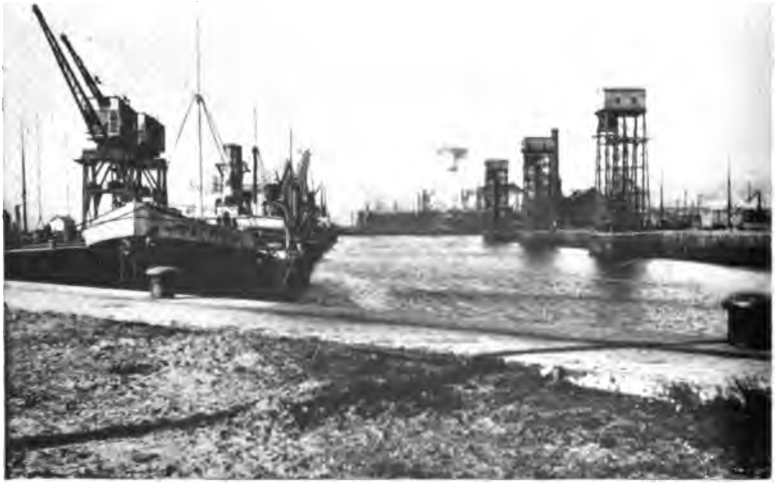
Diving Bell.



View of Glasgow Upper Harbour Looking Westerly.



View of Princes Dock Looking Easterly Showing Double Story Sheds.



Inner Basin—Rothesay Dock Looking Westerly, Showing Coaling Hoists.

The River Clyde and its tributaries have a drainage area of about 1,400 square miles. It is about 102 miles in length from its source among the hills of Lanark County, 2,000 feet above sea level, to Port Glasgow. The river falls rapidly from its source for about one half of the distance to Glasgow, passing through grazing and agricultural lands, and for the remaining distance the river traverses rich mining and agricultural districts where the slope is much lighter.

The first report upon the improvement of the Clyde was made by John Smeaton in 1755, and while his report included but 5½ miles of the river from Glasgow to Renfrew, he then found twelve shoals, four with but 18 inches and one with but 15 inches depth at low water.

The systematic improvement of the Clyde really commenced in 1772 under the advice of John Golbone and the authority of an act of Parliament empowering the Magistrates to deepen the Clyde between Glasgow and Dumbarton, to seven feet at high water of neap tides, and providing for a channel 300 feet in width. Since that time this work has been carried on with a persistence and consistency almost unparalleled in the development of navigable rivers. The bed of the Clyde has been lowered from 24 to 28 feet for 20 miles, and since 1845—but little over a half century—75,679,695 cubic yards of material has been removed.

Today the Clyde has a depth of 22 feet at low, and 33 feet at high water, sufficient to float the great Luscitania from the Scottish shipyard on the banks of the Clyde, where she was built, on her maiden voyage to the sea.

It is interesting to note that the earlier engineers engaged in the improvement of the Clyde considered the width of the river too great for the depth and recommended that jetties be constructed to confine the flow and to obtain the benefit of the scouring action of the current. Acting upon this advice, over 200 jetties were constructed along the upper reaches of the Clyde previous to 1800. This work was followed by the construction of low training walls connecting the jetties, the material dredged from the river by the early primitive methods being deposited behind these walls.

In the 1840 Act of Parliament definite lines were established for the improvement of the river. In most cases they provided for widening to keep abreast of the increase in traffic and in the dimensions and draught of vessels which had grown from 13½ feet in 1821 to 26½ feet in 1900; but this Act also provided for the constriction of certain portions of the river and that all land reclaimed from the river should become the property of the riparian owners. Later much of the same land which had been reclaimed from the river had to be repurchased by the Trustees at great cost to provide sufficient width for the increasing requirements of Clyde navigation. The material dredged was first used for reclaiming and making good agricultural land from the low waste land along the banks of the Clyde. Later the dredgings were deposited at Loch Long, about 28 miles below Glasgow, and now they are carried to a new dumping ground at the mouth of the Firth about 46 miles from Glasgow Bridge.

The greatest natural obstacle encountered in the deepening and widening of the Clyde was the Elderslie Rock discovered in 1854 by the grounding of the "Glasgow", one of the earlier transatlantic steamers. This obstruction was found to be a great mass of whinstone or trap rock extending entirely across the channel and underneath it for nearly 1,000 feet, the surface being but 8 feet below low water. The plan adopted for removing this obstruction consisted of drilling and blasting under water and then of removing the debris by dredging. By 1880 the obstruction had been removed for one-half of the width of the channel to a depth of 14 feet below low water. To complete this work it required the drilling of 16,000 holes and the use of 76,000 pounds of explosives. Over 110,000 tons of rock and boulder clay were removed to obtain a 20-foot channel. This great undertaking was completed in 1886 at a total cost of $340,202.

The systematic dredging of the Clyde since 1824 has required a well organized force and a large equipment. Starting with harrows, plows, and hand dredges, then advancing to the first steam dredger of 1824 with but 12-horse power and a working depth of 13 feet, and from that down to twin-screw dredges 200 feet long by 37 feet broad capable of dredging 600 tons per hour and working to a depth of 40 feet of water. The present dredging equipment of the Trustees consists of five dredges, two steam-digger barges, two diving bells, ten hopper barges of 1,200 tons, two of 1,000 tons, and seven of 400 tons capacity.

"The river is lighted by means of two lighthouses, three light-towers, two lighted beacons, one lightship, and seven lighted buoys".

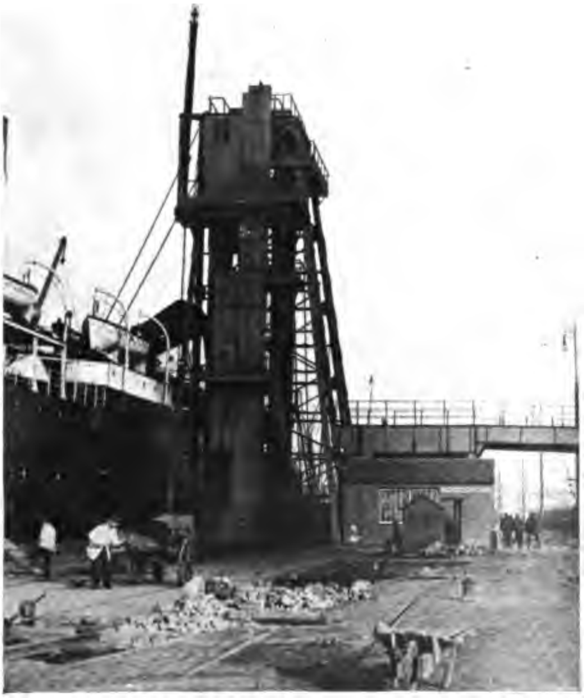
The Harbor of Glasgow includes that portion of the Clyde extending from Albert Bridge to the Kelvin River a distance of about 2½ miles. Its development commenced in a small way by the construction of quays along the river's border. In 1792 the total quayage was but 1,146 lineal feet and the total water area but four acres. Today the quayage of Glasgow is over ten miles in length, sufficient to berth forty or fifty ocean vessels at a time, and the total area of the harbor and docks includes over 181 acres of land and 314 acres of water.

The quayage is divided as follows:

Along the north side of the Clyde	12,561	lineal feet
" " south " " " " . . .	10,425	" "
Kingston Dock	2,469	" "
Queen "	10,002	" "
Prince's "	11,211	" "
Rothesay "	5,541	" "
	52,209	lineal feet

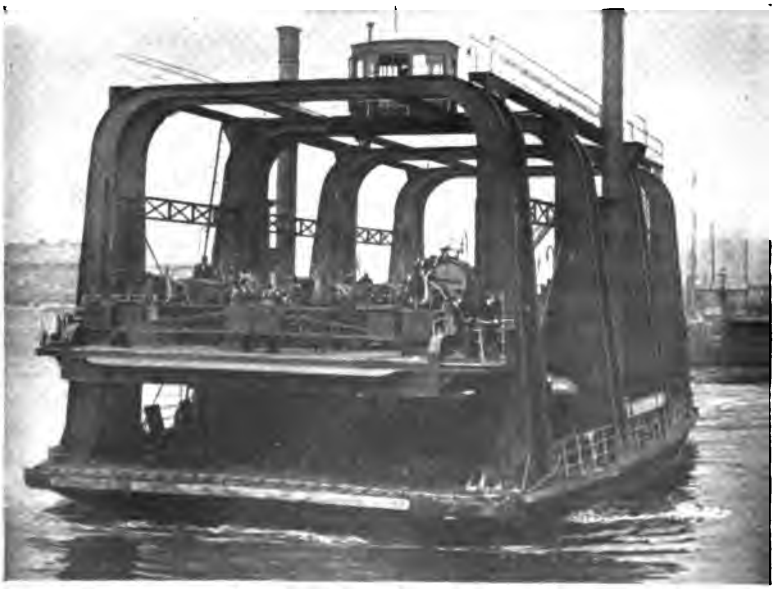
The Rothesay and Queen's Docks are located in the northerly, and the Prince's and Kingston Docks on the southerly side of the Clyde.

Most of the quays are lined with modern one and two story sheds, usually built 15 or 20 feet back of the face of the quays, the total area of



View of 25 Ton Coal Hoist at Princes Dock.

Graving Dock No. 3.
Built in 1898 at a cost of $1,318,936.



Vehicular Ferry Steamer with Elevating Platform.

floor space being about 50 acres. The Clyde Trustees do no warehousing or stevedoring business, all of this being carried on by private enterprise. The sheds are used wholly for goods in transit. The Trustees own over 20 miles of railroad tracks connecting an elaborate system around the docks and warehouses with the various railway systems entering Glasgow. The docks and warehouses are splendidly equipped with mechanical appliances, the Trustees having already provided forty-five steam cranes lifting from three to one hundred and thirty tons; fifty with hydraulic power, having a capacity of from two to one hundred and thirty tons; and twenty-two electric cranes capable of lifting from three to thirty-two tons.

The Glasgow Harbor is also provided with three graving docks, the first being built in 1875, the second in 1886 and the last in 1898. The Clyde banks are lined with great industries for several miles below Glasgow, and the sight from a steamer passing down the modern channel is one never to be forgotten. The tonnage of ships built by the large Clyde ship-builders has increased from less than 50,000 in 1860, to over 600,000 at the present time.

The Clyde Trustees operate ferries across, and steamers up and down the Clyde. While the ownership of property by the Trustees on the banks of the Clyde is much less complete than that of "The Mersey Docks and Harbour Board", at Liverpool, large areas have been purchased on both banks for a distance of nine miles from Glasgow, to provide for the future requirements of Clyde navigation.

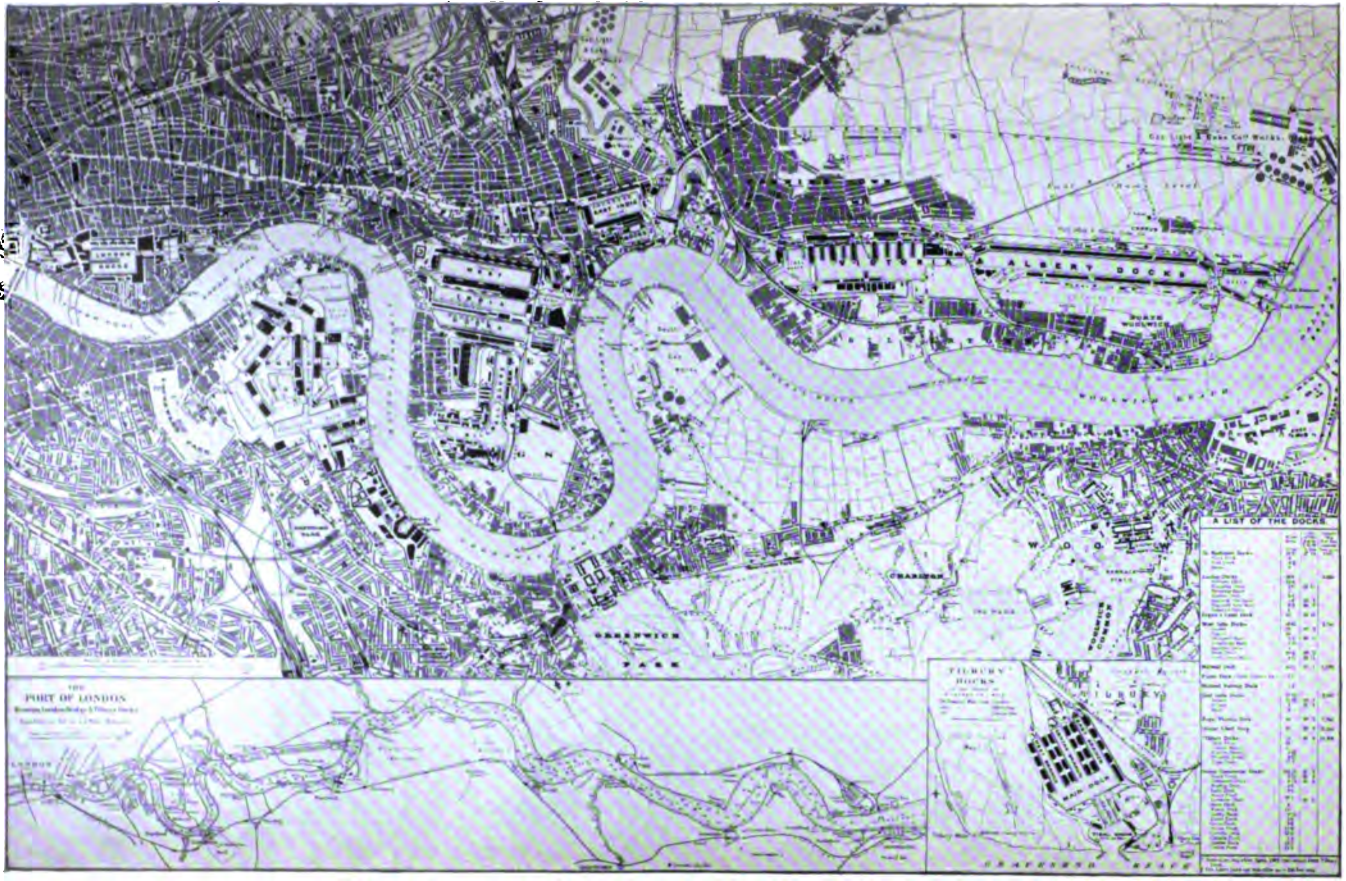
THE PORT OF LONDON.

The Docks of London are so spread out along the Thames River for a distance of 26 miles from London Bridge that they impress one as being disconnected, unco-ordinated and poorly managed in comparison with those of Liverpool, Antwerp, Rotterdam and Hamburg. London has so long been the leading port of the world in respect to the amount of shipping and goods which enter, that only within the last decade has the keen rivalry and phenomenal growth of some of the younger continental ports impressed her with the great importance of keeping abreast of modern requirements by providing better facilities for navigation.

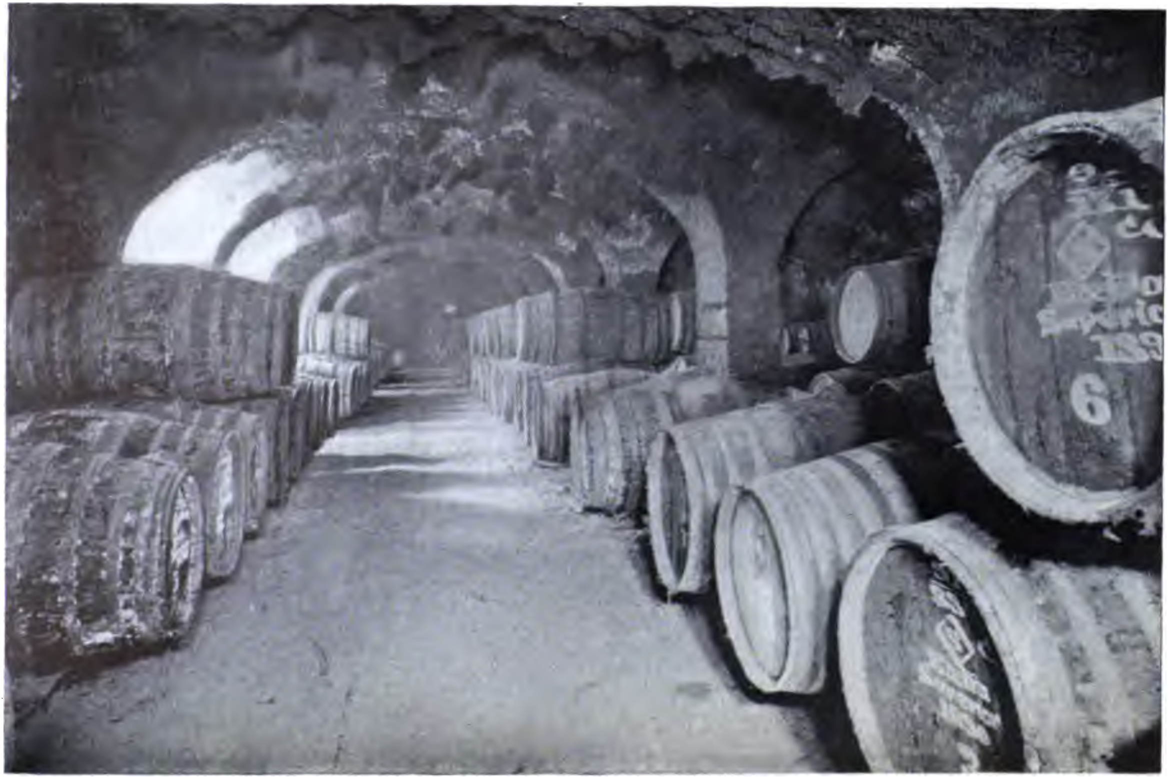
The Royal Commission appointed to investigate this subject speaks in its 1902 report of the natural advantages of the Port of London as being the "geographical position of the port; the magnitude, wealth and energy of the population behind it; the fine approach from the sea; the river tides strong enough to transport traffic easily to all parts, yet not so violent as to make navigation difficult, and land along the shores of a character suitable for dock construction and all commercial purposes. The existence upon the Thames of the greatest market and centre of consumption in the world, it is contended, bestowed upon the port a huge practical monopoly. London was sure of a trade of which rivals could not deprive it, and, in consequence, had not the usual incentives to affect improvements. Other ports in keen competition with each other for the general world-trade, have improved their organization and physical advantages in recent years, while London has in these respects remained much more nearly stationary. Hence, it is suggested, both the inland and re-export trade of London may have lost ground, relatively to other ports, in consequence of the improvements in other maritime cities of the United Kingdom and in adjacent countries. So far as relates to the re-export of foreign and colonial produce the figures seem, to some extent, to correspond with this view."

Mr. D. Owen attributes the failure of the Port of London to maintain its rate of growth as a distribution port to causes of a wider character, as follows:

"Formerly London was a distributing and collecting port, as being the world's trade focus, the world's market. The cargoes came to the biggest market. The Low Countries and the Continent bought in London and sent goods to London for shipment. London was the 'Goods Exchange' for Europe to a large extent. Foreign produce formerly was largely a prohibitive luxury, only available to the few. Foreign ports had no use for shiploads; they wanted parcels; shiploads came to London. The development of production, cheapening of transport, abolition of duties, increase of population, spread of wealth, and the introduction of steam factories, altered the situation. The Continent became able to swallow whole shiploads, but Continental ports being undeveloped and unhandy, and the force of ancient usage being strong, cargoes continued to come to London.



Plan of the Thames River and London Docks.



Wine Vaults, London Docks. Capacity Over 8,000,000 Gallons.

In 1863 the abolition of the Scheldt dues threw open Antwerp, which at once began to compete with London. The Suez Canal was opened, trade increased enormously, and ships began to be ordered, with full cargoes, to Antwerp. The new departure extended to Hamburg, Rotterdam, Havre, and other places, and all these ports began competing furiously with one another, and all with London. Moreover, the practically new ports of Marseilles, Genoa, and Trieste now intercept cargo which formerly passed through the Straits of Dover, and these ports are greatly developing. This competition, powerful as it is, is still in its infancy. Continental ports are spending lavishly on improvements, and already British ship-owners prefer Antwerp to London, and would as soon go even to Hamburg as to London. It seems inevitable that the business of London as a port of distribution will decline."

With all the natural advantages, and the fact that London is the greatest city in the world with a population of 7,000,000 and growing rapidly, the increase in the commerce of the port is much less than the increase in population and less than the increase in commerce of the ports of New York, Antwerp and Hamburg. This is more especially due, first, to the fact that London, previous to 1909, had no centralized authority to administer the affairs of her great port with that singleness of purpose, so conspicuous in the work of "The Mersey Docks and Harbour Board" of Liverpool, and the "Clyde Trustees" of Glasgow,—and secondly, to the fact that the ownership, maintenance and management of the quays and docks was so divided between many different individuals and corporations, that it was almost impossible to obtain that unity of action so important to the development of a great port. Previous to 1909 there were no less than five controlling authorities on the River Thames.

I. The Thames conservancy, created by a parliamentary act of 1857 had charge of

1. The Government and regulation of all vessels within the port.
2. The improvement and completion of the navigation of the river.
3. The appointment of harbor-masters who have power to regulate the whole traffic on the river, the movements and position of vessels, and the manner of discharging and loading them.
4. The removal of wrecks and other obstructions.
5. Dredging for the purpose of maintaining and improving the navigation, and the shortening of bends.
6. The licensing of docks, piers and embankments, stages and cranes; the placing and maintenance of moorings; the erection of piers and landing stages; the placing and maintenance of navigation beacons; the carrying out of the Explosive and Petroleum Acts so far as they affect the river.

II. The Trinity House of Deptford Strond was the general Lighthouse Authority for England and Wales, the Channel Islands and Gibraltar. This authority had charge of the buoying, lighting, and the pilotage of the Thames.

III. The Waterman's Company had charge of all questions connected with the licensing of Lightermen and Watermen.

IV. The Port of London Sanitary Authority had charge of all

Two other dredgers are constantly employed in removing shoals above Gravesend, and the Authority are also widening and deepening the channel between London Bridge and Teddington, where there is a considerable traffic by barges and other vessels of light draught.

DOCKS.

In addition to the control of the waterway the Port of London Authority own and manage the Docks, formerly vested in the London and India, Surrey Commercial, and Millwall Dock Companies, whose land and water areas consisted of 2,467 acres. There are also 10 acres of city properties and 106 acres of land at Crossness, making a total area of 2,583 acres. The river frontage of the dock properties is about 3 miles in length. There are 28 miles of dock quays available for shipping. The machinery employed at the Docks is worked principally by hydraulic power, but electricity has been introduced during recent years. There are 1,468 cranes and lifts of varying capacity, including sheer legs lifting up to 80 tons, and 5 floating derricks lifting from 15 to 50 tons at wide radius. Amongst the movable plant are 23 tugs and 42 locomotives for use in and about the docks and railways. There are about 120 miles of railways.

The purchase price of the three Dock undertakings was paid by the issue of Port Stock in substitution for the various Dock stocks, the amounts given being:

3% "A" Stock	$44,479,459
4% "B" Stock	64,204,605
	$108,684,064

The following describes briefly the individual docks and equipment:

I. ST. KATHARINE DOCK.

This Dock adjoins the Tower of London and is within a few minutes' walk of Fenchurch Street, Aldgate, and Mark Lane Stations. The northern railway companies have goods stations within a few yards of the Dock, and the Tower Bridge provides a short route to the goods stations on the southern railways.

The area of the Dock is 23 acres—10 acres being water space.

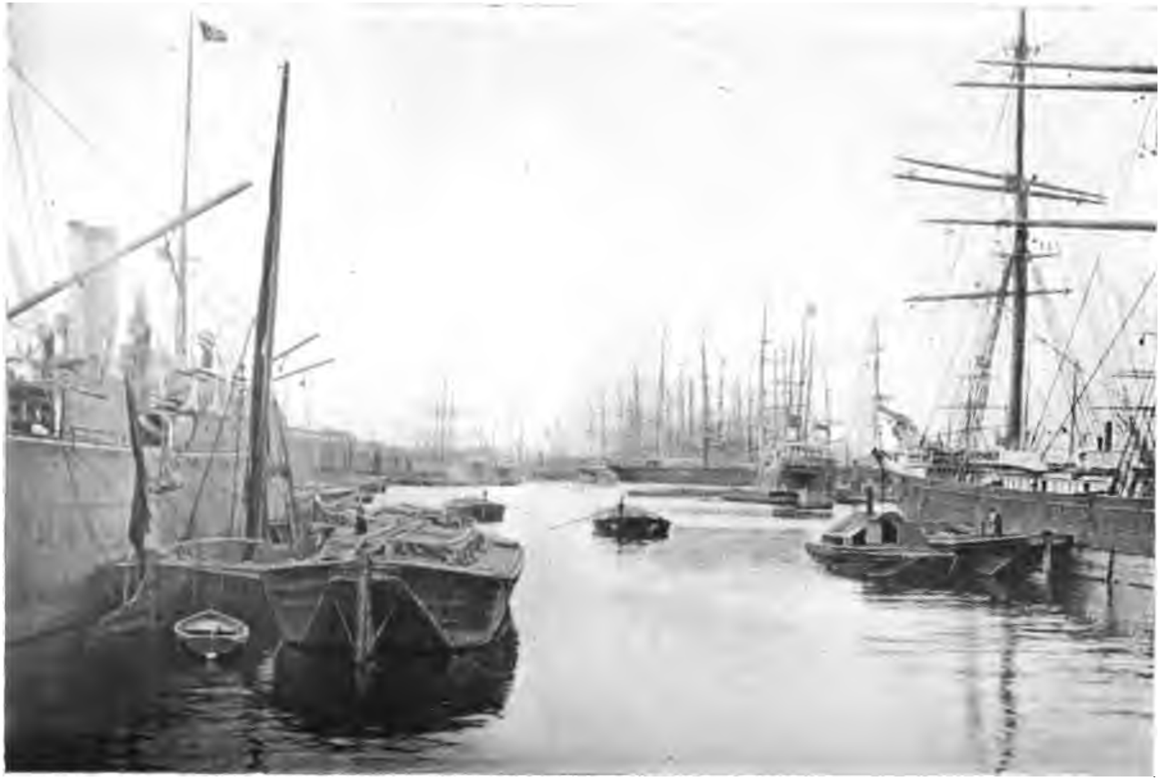
The entrance lock is 180 feet long by 45 feet wide, with a depth at high water spring tides of 28 feet on the outer sill and 24 feet on the inner one.

The Dock is accessible only to vessels of moderate size—such as those trading in the Coasting and Continental services.

The storage capacity of sheds and warehouses is equivalent to 86,000

The Western Dock—London Docks.

The Centre Branch Dock—Tilbury Docks.
1,600 feet in length and 300 feet in width.



The West India Docks.
Area nearly 300 acres, large enough to contain at one time more than 450 West India Merchantmen.

tons, and in addition the wine and oil vaults have a capacity of 37,500 pipes.

There are 68 hydraulic cranes and other lifting machinery.

II. LONDON DOCK.

This system adjoins the St. Katharine Dock and occupies 100 acres, 40 of which are water. The storage capacity of sheds and warehouses is 174,000 tons, and there are wine, spirit, and oil storage vaults of 105,000 pipe capacity. The machinery includes 132 hydraulic and other cranes (one of 25 tons lifting power).

There are four entrance locks, three being in use and one closed:

	Length	Width	Depth				
	ft.	ft.	ft.				
Wapping	170	40	23 at	High	Water	Spring	Tides.
Shadwell (Old)	180	45	24 "	"	"	"	"
Shadwell (New)	350	60	28 "	"	"	"	"
Hermitage (Closed)	150	40	21½	"	"	"	"

By means of pumps the water in the Dock is continuously maintained at a level of 3 feet 6 inches above Trinity High Water Mark.

This Dock is available for vessels up to 4,500 tons.

Wool is shown and stored, and about 700,000 bales pass through the dock warehouses annually. The accommodation provided for the wool business in the London and St. Katharine Docks has a floor area of 1,400,000 feet. The imports into London annually are about 1,600,000 bales, weighing 250,000 tons, and of an estimated value of $97,200,000.

Wines and spirits.—The principal wines stored are port, sherry, and madeira. The brandy vaults cover an area of four acres. In connection with the wine and spirit business there are 46 vats, capable of holding 102,000 gallons, which are used for blending purposes.

In the bottling department some 125,000 dozen bottles are filled and packed yearly.

III. SURREY COMMERCIAL DOCKS.

These docks are situated on the south or Surrey side of the Thames (at Rotherhithe), about 1½ miles from the Tower Bridge. The system covers an area of 451 acres, and includes the Surrey Canal, which extends from the Docks to Camberwell, is upwards of four miles in length, and has an area of 70 acres. In addition to the deep water area of 103 acres there are ponds for the storage of timber covering 63 acres.

There are four entrance locks, viz.:

	Length ft.	Width ft.	Depth ft.	
Greenland Lock	550	80	33	at High Water Spring Tides.
Surrey Lock	250	50	27¼	" " "
South Lock	220	48	27	" " "
Lavender Lock	320	34	18½	" " "

The Surrey Commercial Docks are the chief depot for the soft wood trade of London, as much as 780,000 loads being received for storage in the course of twelve months. The piling grounds are 200 acres in extent, and shedding of 48 acres has been provided for the storage of wood under cover, with a capacity of 233,000 loads.

The Dock Quays are 6 miles in length, and there are 8 miles of paved and macadamized roads.

The new Greenland Dock, the most recent addition to the system, was opened in 1904, and is 2,250 feet in length, 450 feet in breadth, the water area being 22 acres, with quayage upwards of a mile in length. The Dock will accommodate vessels of 10,000 tons.

In the Greenland Dock special provision has been made for the accommodation of Canadian produce in warehouses of a capacity of 2,000,000 cubic feet, providing cold air and cold storage. A large trade is also done in the storage of grain.

IV. WEST INDIA DOCKS.

These docks are situated on the northern part of the Isle of Dogs, Poplar. They are 231 acres in extent, 105 acres being water. They consist of three parallel sets of docks, each about half a mile long, viz,—The West India Import Dock, the West India Export Dock, and the South West India Dock, with four adjoining basins. The Poplar Dock, at the eastern end of the property, is leased to the North London Railway Company, and is used for the discharge of coal and other goods for transport by railway.

There are four entrance locks, two only being in use, viz.:

	Length ft.	Width ft.	Depth ft.	
Blackwall	480	60	30	at High Water Spring Tides.
South Dock	480	55	29	" " "

Vessels up to 7,000 tons can be received. The storage capacity of the warehouses is 195,000 tons, and that of the vaults 40,000 puncheons. There is refrigerated accommodation for 114,000 carcasses of sheep.

There are four miles of quays for discharging.

V. MILLWALL DOCK.

This dock is situated on the Isle of Dogs, and has an area of 233½ acres, 35½ acres of which are covered with water. The entrance lock in Limehouse Reach is 450 feet long, 80 feet wide, and 28 feet deep at high water spring tides, and vessels up to 9,000 tons are accommodated.

An important general trade is done with vessels from the Baltic, Northern and Southern Europe, and North and South America, but the special feature at Millwall Dock is the grain trade. About 9,000,000 quarters of grain are reported annually at the Customs for discharge in the Docks of London. About one-third of this quantity is discharged at the Millwall Dock. The new Central Granary, 250 feet long by 100 feet wide, and consisting of 13 floors, has a floor storage area of 7 acres, and will accommodate about 120,000 quarters. Immediately in front of this granary, and on the quay side, are four nests of silos, with a storage capacity of 18,000 quarters, and on a dolphin running parallel with the quay is placed powerful pneumatic machinery for discharging the grain from the importing vessels.

VI. EAST INDIA DOCK.

The East India Dock is situated about half a mile from the West India Dock. There are two entrances, viz:

	Length	Width	Depth
	ft. in.	ft. in.	ft. in.
The Western	210—6	47—5	24—10 at High Water Spring Tides.
The Eastern	100—0	65—0	31— 0 " " " "

Vessels of 8,000 tons burden can dock in the basin. The area of the dock is 71 acres, 33 acres being water.

The storage capacity of the warehouses equals 34,500 tons. There are 1½ miles of quays. The dock is principally used by the steamers of the Union-Castle Line.

The entrance to the Blackwall Tunnel is close to the main gate of the East India Dock. Opposite the Tunnel is the Poplar Hospital for Accidents—a hospital originally established, and still used, for the many cases of accident which arise at the docks and surrounding factories.

VII. ROYAL VICTORIA AND ALBERT DOCKS.

The Royal Victoria and Albert Docks, extending from Blackwall to Galleons Reach (a distance of 3 miles), are the largest under control of the Port of London Authority. The docks are reached by train from Fenchurch Street Station in about 15 minutes, the stations for the Victoria Dock being Custom House and Tidal Basin, and, for the Royal Albert Dock, Galleons, Manor Way, Central and Connaught Road.

The water area consists of 182½ acres, the combined land and water area being 767 acres.

These docks are within the London cartage radius. There are three entrances. The Victoria Dock entrance is in Bugsby's Reach. 325 feet long, 80 feet wide, and 28 feet deep at high water spring tides; and the Royal Albert Dock entrances are in Galleons Reach, viz:

Galleons (Upper) 550 ft. long, 80 ft. wide, 30 ft. deep at High Water Spring Tides.
Galleons (Lower) 550 ft. long, 80 ft. wide, 36 ft. deep at High Water Spring Tides.

Vessels up to 12,500 tons can dock here with every facility.

The floor area of the sheds and warehouses is 71¼ acres, with a storage capacity equivalent to 281,000 tons of goods. The cold storage warehouses in the Victoria Dock are capable of receiving 568,000 carcasses of sheep. The length of quays is 9 miles. There are 184 hydraulic and other cranes of varying calibre.

VIII. TILBURY DOCK.

The Tilbury Dock, situate on the north side of the Thames, opposite Gravesend, is reached by the London, Tilbury & Southend Railway, in about 40 minutes from Fenchurch Street Station.

The system consists of a main dock with three branch docks, connected with a tidal basin by means of a lock 700 feet long and 80 feet wide, with three pairs of gates. The main dock is 1,800 feet long by 600 feet wide. Each branch dock is 1,600 feet long, the width of the centre one being 300 feet while the two outer ones have an average width of 250 feet. The total water area in the main and branch docks is 54 acres. The basin is 17½ acres in extent. The total area of the estate is 591 acres. The depth in the tidal basin at high water spring tides is 45 feet, and there is never less than 26 feet. In the main and branch docks the depth at spring tides is 38 feet. The largest vessels using the Port of London are accommodated at the Tilbury Dock, the entrance lock of which is of sufficient size to admit vessels of 25,000 tons.

The floor area of sheds and warehouses is 23 acres, and the storage capacity equals 83,000 tons of cargo. The quays are 2¾ miles in length.

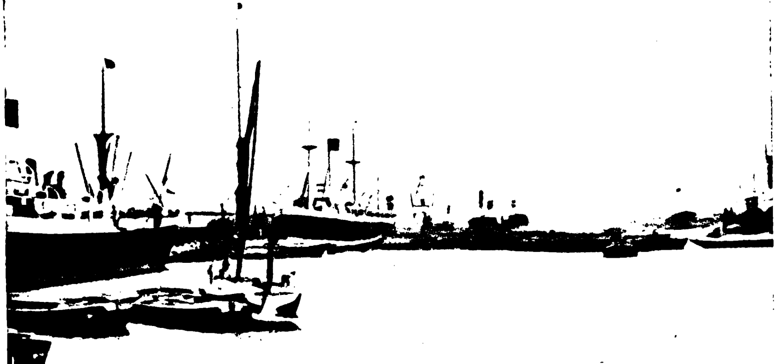
The principal lines using this dock are the Peninsular & Oriental, Orient, Atlantic Transport, White Star, Clan, Anchor, and Bibby Lines. There is a daily service to Ostend, and twice a week to Hamburg.

The Tilbury Hotel, containing 100 bedrooms, is the property of the Port of London Authority.

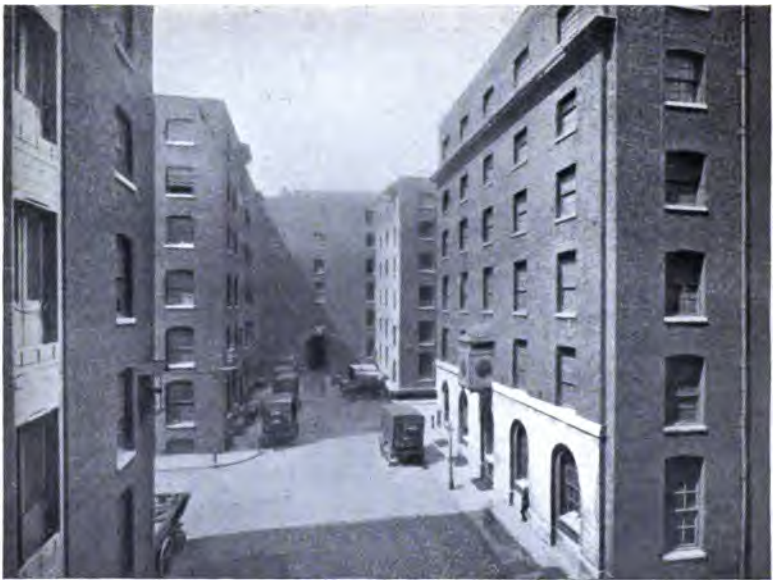
IX. TOWN WAREHOUSES.

Cutler Street Warehouses are the largest of the group, and are situated near Houndsditch and Bishopsgate Street. They occupy 5½ acres of ground, and are provided for the reception of the more valuable classes

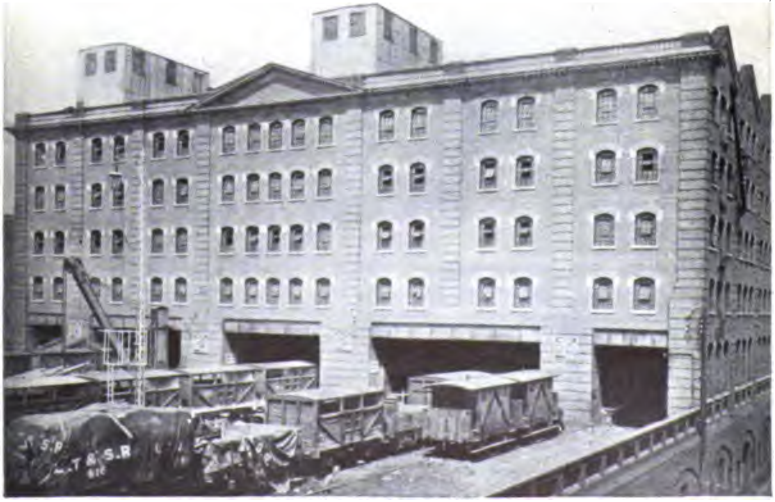
Royal Victoria Dock.
View from the Western End.



Royal Albert Dock—Looking Eastward.



Cutler Street Warehouses—Covering an Area of 5½ Acres.



Commercial Road Warehouse.

Built over the Goods Depot of the London, Tilbury and Southend Railway, and designed for traffic to and from the Tilbury Docks.

of goods. The principal articles stored are tea, Oriental carpets, chinaware and japanware, silk, silk and cotton piece-goods, ostrich feathers, fancy feathers and bird skins.

Crutched Friars Warehouse is situated in Crutched Friars, and is used for cigars, cigarettes, furs, drugs, and other articles of value.

Commercial Road Warehouse, situate at the City end of Commercial Road, is built over the Goods Depot of the London, Tilbury and Southend Railway, and was designed for the accommodation of traffic to and from the Tilbury Dock. All classes of goods are dealt with, the chief being Indian and Ceylon tea.

West Smithfield Cold Air Stores, in St. John Street, the more recently constructed of the Town Warehouses, is for the storage of refrigerated meat, etc. It adjoins the Smithfield Meat Market and provides accommodation for 100,000 carcasses of sheep.

X. DRY DOCKS.

There are two in the Royal Albert Dock. (1) Length 501 feet, 85 feet wide at cope, 66 1-3 feet wide at entrance, 22 feet on sill at Trinity High Water. (2) Length 408½ feet, 77 feet wide at cope, 64½ feet wide at entrance, depth on sill 22 feet at Trinity High Water.

One at Millwall Dock, 450 feet long, 65 feet wide, and 20 feet over blocks at Trinity High Water.

Two at Tilbury Dock—the largest in the Port—each capable of being used either as a single dock, 850 feet long, or as separate docks of varying lengths, having a depth on sill of 35 and 30 feet respectively at Trinity High Water. The two docks are 70 and 60 feet wide respectively. The division of each set is made by means of caissons.

XI. SURPLUS LANDS.

Of the lands transferred to the Port Authority about 777 acres are available for Dock Extensions, and are situated as follows:

Victoria and Albert Docks	282	acres
Tilbury Dock	360	"
Crossness	106	"
Surrey Commercial Docks	7	"
Millwall Dock	22	"
Total	777	

The business done at the Port of London is given in the first annual report of the new Board, as follows:

The total net tonnage of vessels that entered and cleared with cargoes and in ballast from and to foreign countries and British Possessions and Coastwise at the Port of London during the year 1909, was 35,151,799 tons, as compared with 33,768,599 tons during the year 1908, an increase of 1,383,200 tons.

Of the tonnage referable to the year 1909, 20,228,014 tons entered and cleared from and to Foreign Countries and British Possessions and 14,923,785 tons entered and cleared Coastwise.

The shipping which entered and left the Port of London and paid Port tonnage dues during the twelve months ending 31st March, 1910, amounted to 28,579,648 tons. Of this shipping 11,143,551 tons discharged and loaded in the River, and 17,436,097 tons discharged and loaded in the Docks.

The shipping that used the Docks was as follows:

	Net Register Tons	
Foreign—inwards	8,526,196	14,845,737
Foreign—outwards	6,319,541	
Coastwise—inwards	1,592,514	2,590,360
Coastwise—outwards	997,846	
		17,436,097

Soon after the new "Port of London Authority" assumed charge of the Dock System of London, an examination was made of the property by the Chief Engineer and he estimated that $3,575,069 should be expended to insure the efficient and safe working of the undertaking. About $340,200 of this amount has been authorized for the most urgent repairs and the balance will soon have to be expended in addition to the cost of maintenance.

The Board has authorized the widening and deepening of the Channel of the Thames, and when completed it will have the following dimensions: Form the Nore Lightship at the mouth of the Thames to Crayfordness 1,000 feet wide and 30 feet deep; thence to Albert Dock 600 feet x 30 feet; thence to Greenland Dock 600 feet x 20 feet; thence to the Thames Tunnel 600 feet x 16 feet deep; thence to the Tower Bridge 500 x 14 feet; thence to the London Bridge 450 feet wide by 14 feet deep.

The work of the "Port of London Authority" is divided among six standing committees, as follows:

Works and Improvements Committee
Dock and Warehouse Committee
River Committee.
Finance Committee.
Staff and Stores Committee.
Parliamentary Committee.

Under the principal officers of the Board there are five departments, viz.:

Secretary and General Manager's Department; Engineer's Department; Docks and Warehouses Department; River Department; Finance Department.

The entire force under the Board now consists of

Salaried Staff		1,156
Wages Staff—	Permanent men on the establishment	5,074
	Not established, but regularly employed by the week	2,123
	Extra men, daily average	2,944
	Total	11,297

THE PORT OF ANTWERP.

Belgium, in proportion to its size, possesses one of the most intensely developed systems of waterways of any European country, the total length of main line canals being 1,015 miles of which 900 miles are owned by the State and 115 miles by the Provinces, Communes, or Concessions.

Belgium also possesses a highly developed system of railways, and it is a great industrial country.

It is said that Belgium is Antwerp, and Antwerp is Belgium. To those who have visited Antwerp and seen the splendid railway approaches and terminals, completed within recent years, and the unexcelled system of quays and docks, all developed within the last half century, the above statement seems none too strong. Within the above period, Antwerp as a port has risen to the commanding position of second place among the North Sea Continental Ports, and in some respects to leadership among the world's greatest ports.

The Port of Antwerp is located on the River Scheldt, at the head of deep sea navigation, about 53 miles from the North Sea, and by means of the highly developed systems of railways and waterways has direct communication with the three adjacent countries, France, Holland and Germany.

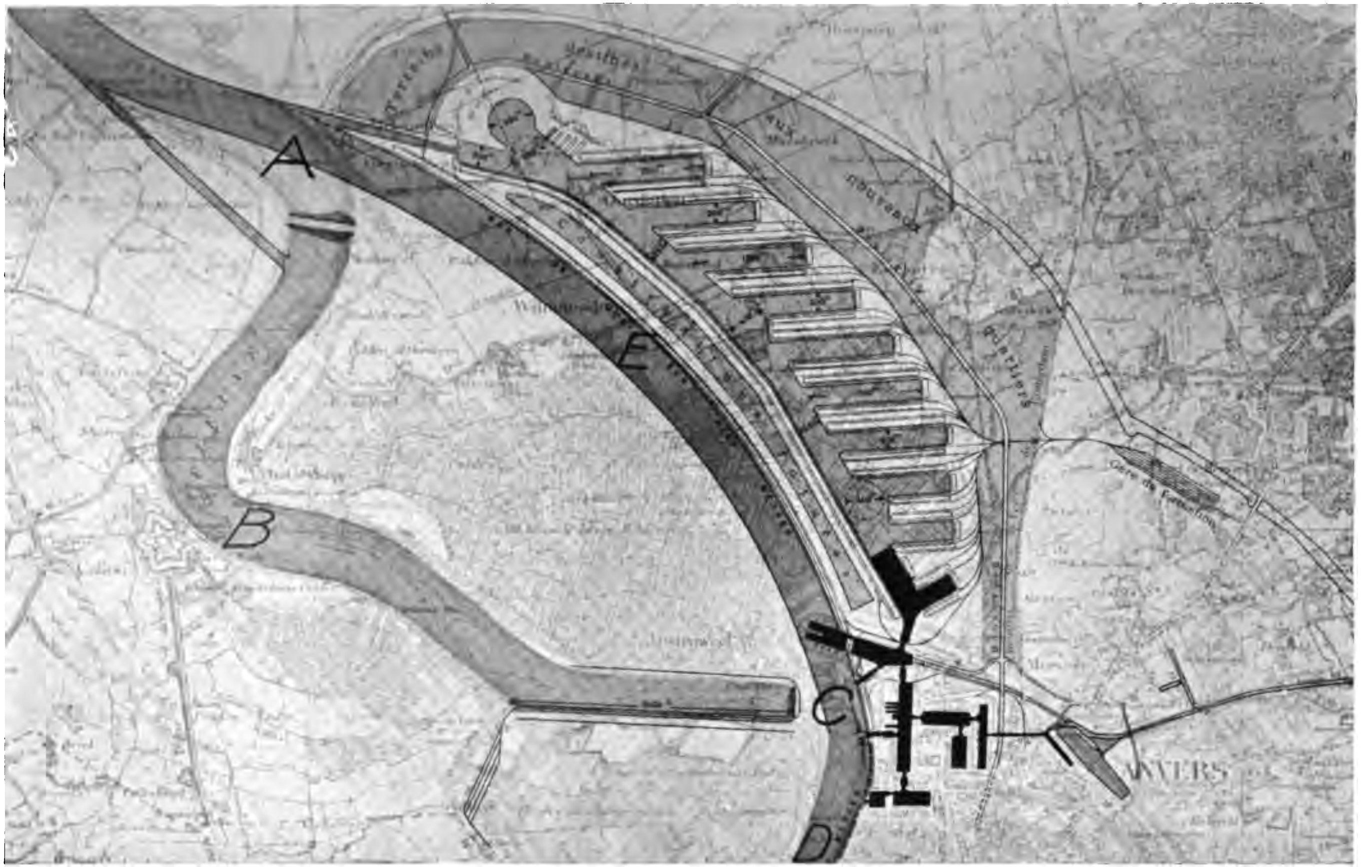
The Port of Antwerp is administered, and most successfully too, by the Municipality, through a Harbor Commission consisting of five members selected by the City Council from among its own members with the Mayor as Chairman. The State owns a small portion of the river front and has charge of the policing, lighting, and buoying of the river, the management of the ferries, and the collection of dues.

On account of the State and City being thus jointly interested in the port, there is an advisory commission consisting of nine members, five representing the State, two the City, and two being members of the Chamber of Commerce.

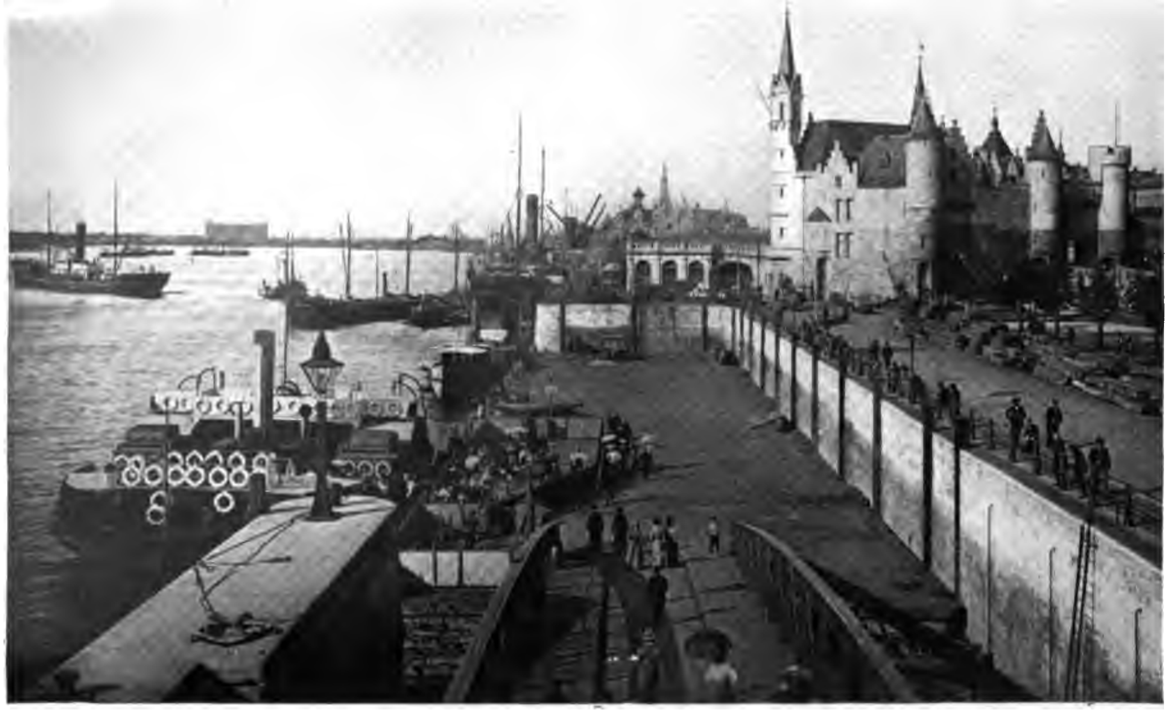
The Port is located wholly on the city side of the River Scheldt, and consists of two entirely distinct parts, (1) the river port bordered by quay walls and wide quays, and (2) the interior port consisting of a group of ten locked basins, divided into maritime and barge docks. At the former river quays, vessels rise and fall with the tide which fluctuates about 13 feet, while at the latter group the water level is constant and not subject to changes in the water level of the Scheldt.

There now are about 12 miles of quays, 92 acres of warehouses, sheds, etc., and 375 acres of water in the various basins, including the River Scheldt. The length of the river quayage is 18,040 feet, and that of the docks, 54,120 feet. An extensive system of railway tracks amounting to 96.88 miles connects the river quays and docks with the railway systems entering Antwerp.

There are 105.7 acres of sheds, mostly of the single story type, and several warehouses and storehouses. Many of the older sheds and some



Present Dock System of Antwerp shown in black near C. Present course of River Scheldt A, B, C, D. Proposed "Grande Coupure" ·at cut) in river channel A, E, C. Proposed great extension of dock system shown to the right of new river channel C, E, A.



Large Floating Pontoon.
Similar to the "Prince's Landing Stage" at Liverpool.

of the new ones are of the open type, while some of the later ones are enclosed. The new sheds are especially well built of brick, and steel, with rolling doors, and wholly fireproof.

The river quays are appropriated especially for the use of regular lines of steamers and coastwise vessels. They were built at two different dates, and are generally spoken of as the "Old River Quays", and the "New River Quays". The Old Quays were built by the State between 1878 and 1884, but the City of Antwerp provided the sheds and mechanical equipment.

At these quays there is a floating landing stage with a movable bridge for passenger service similar to those used upon the Mersey River at Liverpool.

In 1895, by mutual agreement, the State built new quays, 6,560 feet long, beyond the old quays, and here again the City provided the entire equipment. These quays were built upon a more liberal plan than the former ones, as much more room was available for this purpose. The sheds adjacent to these quays cover an area of 18.9 acres and cost $386,000.

Fifty-one "half-arch" cranes handle goods to and from these sheds and vessels. The roof of the sheds at two of the quays are built flat and in the form of a terrace or promenade, from which a splendid view of the river and shipping activities can be obtained.

The following table gives the dimensions of the Antwerp Docks:

Name of Dock,	Length ft.	Width ft.	Surface acres.
Bonaparte Dock,	492	558	6.3
Guillaume Dock,	1,246	492	14.4
Junction on Kattendyk Dock,	279	164	1.1
Kattendyk Dock,	3,149	459	33.3
Kattendyk Lock Chamber,	361	230	1.8
Timber Dock,	1,706	492	19.2
Campine Dock,	1,148	525	13.8
Asia Dock,	2,001	328	15.1
Junction on Lefebvre Dock,	377	164	1.4
Lefebvre Dock,	—	—	31.8
American Dock,	—	—	16.6
Basin Dock,	2,050	820	38.6
Wet Dock, North,	1,722	590	24.0

The two new North Docks, the last ones provided, were three years in building, were opened in 1907, and cost $1,447,500, including quays, sheds and the mechanical equipment. They are known as the "Basin Canal" and the "First Wet Dock". Their widths are respectively 820 feet and 590 feet each, and the depth of water is 31.2 feet with provision for deepening it to 36 feet. The closed sheds around these docks cover an area of 3.4 acres, and the open sheds 3.5 acres.

Antwerp also possesses six dry docks which are available for all parties needing such facilities. Dues are charged in proportion to the vessel tonnage and the time the docks are occupied.

The present six dry docks are insufficient, and a new one estimated to cost, with all fittings, over $965,000 was commenced in 1910 and will probably be completed by 1913. This dock will be 722 feet long, and have a waterway of 75 feet.

There are over 156 movable hydraulic cranes of 3,308 and 4,410 pounds capacity scattered over the quays of the various docks.

The City maintains a fleet of tug boats and dredges to assist navigation and to maintain a sufficient depth of water in the river, basins, etc. The amount of dredging in 1909 amounted to 457,800 cubic yards.

There are two principal freight stations, the Antwerp Docks with 96.9, and the Antwerp South and River Quays with 66.5 miles of railroads. Some idea of the tremendous amount of business done at these stations can be gained from the fact that the average traffic of the former station is 3,500, and of the latter, 2,000, or 5,500 trucks arriving and departing from the two stations daily.

That Antwerp has been hard pressed to provide new, enlarged and better facilities fast enough to keep up with the phenomenal growth of the port can be seen from the following tables showing the rate of increase in the commerce of the port:

SEA NAVIGATION.

Year	Number of Vessels Entered	Tonnage of Vessels
1900	5,244	6,691,791
1901	5,209	7,510,938
1902	5,607	8,427,779
1903	5,761	9,131,831
1904	5,852	9,400,335
1905	6,034	9,850,592
1906	6,495	10,884,412
1907	6,284	11,181,226
1908	6,135	11,051,644
1909	6,470	11,940,332

This table also shows the increase in the size and carrying capacity of the vessels entering the Port of Antwerp, for while the number of vessels entered between 1900 and 1909 increased by but about 24 per cent. the tonnage in the same period increased nearly 100 per cent.

The growth of the Interior Traffic for the same period, follows:

Kattendyk Dock.
3149 feet long, 459 feet wide and 33.3 feet deep.

View of the Grand Basin.

Open Sheds on the River Quays.

South Promenade of River Quays.

Furnishing a splendid view of shipping activities on the River Scheldt. Goods pass to and from the ships and open sheds underneath the promenade.

Year	Number of Vessels Entered	Net Tonnage
1900	32,990	5,503,670
1901	32,765	5,795,027
1902	32,120	6,287,716
1903	33,940	6,964,328
1904	36,077	7,723,062
1905	36,651	8,155,696
1906	38,149	8,406,895
1907	37,302	8,138,864
1908	37,359	8,270,779
1909	39,705	9,003,069

Not content with the recent great improvements of the Port of Antwerp, the officials have now planned extensions so large and so comprehensive in comparison with the present system of docks, as to challenge the admiration of the world. The following from "The Port of Antwerp", describes the great extensions as planned.

"To enable commerce to expand naturally and continually, the Public Powers have grasped the fact, that, however vast the present installation may be, they must be progressively enlarged and extended.

Over fully a year ago, the extension alone, about 3,280 feet of the Canal Dock, was begun, and also the construction of wet docks Nos. 2 and 3.

These new installations will increase the expansion of the quays and surface of the docks to 18,040 linear feet, and 164 acres respectively. They will involve an expenditure of something like $2,702,000 not including the quay gearing, and will take a good three years time to complete. Before these works are finally completed, the Government will probably have started excavating the Canal Dock, some 4.35 miles in length by 820 feet in width, and also constructing some immense sea locks at Kruisschans, thus connecting the Canal Dock with the Lower Scheldt by means of a wide waterway.

In three years also from now, the building of the large Dry Dock, previously referred to herein, will be completed.

The wet docks, 9 in number, 656 feet in width by 3,936 feet in average length, are to be constructed by the City, proportionately with the increase in traffic.

The installations for small craft navigation are likewise to be enlarged and improved; a reach of the fortification moats, between the Breda Gate and the Schyn Gate will be arranged in the form of an interior barge dock.

The junction canal between River Meuse and the River Scheldt (the Campine Canal), split into a large section, will flow freely into this new dock, as well as into the Lefebvre Dock, and will, besides, conserve that part of the canal which at present flows into the Asia Dock.

The City has decided to construct a dock for Corn lighters between the two first wet docks. A scheme for arranging a dock for coasting vessels behind the d'Herbouville Quay in the South is under construction.

The various schemes will take ten years to execute, and the following table will afford some figures for comparison:

	Present day Situation	Sit. about 1920, after the various works described above have been executed.
Surface of Docks,	230 acres	1,260 acres
Length of Quaywalls and Slopes	9.94 miles	31 miles
Area of Sheds,	141 acres	840 acres

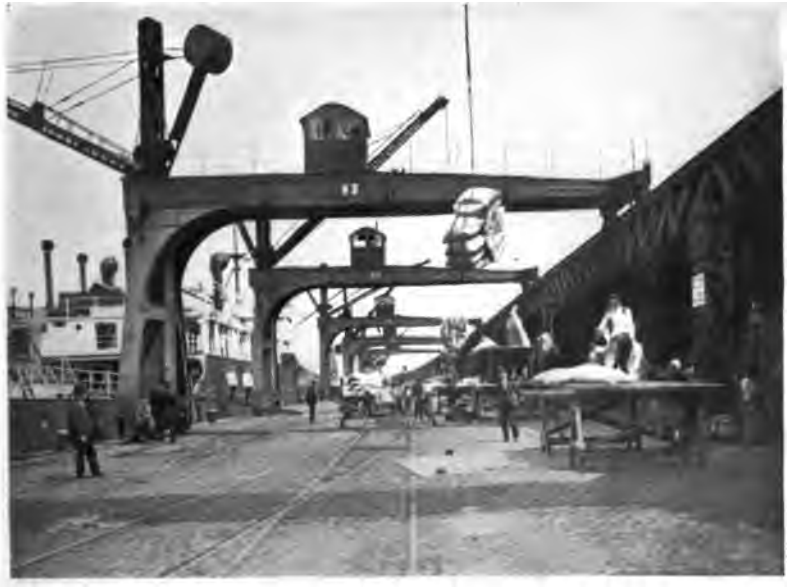
A shifting station, vast in extent, on the present territory of Merxem is in full course of construction. A large boulevard winding around the new maritime installations will shortly be laid down, and also a "Transporder" bridge, connecting the two banks of the Scheldt, will be constructed over the up-stream.

The plan for the construction of one or several tunnels under the river are being rapidly pushed forward, and the State has decided to improve the ferry communications between the 'Tete de Flandres' and the floating landing stage at the 'Canal au Sucre' by erecting a large lift, specially for hoisting up vehicles to the level of the quay at low tide.

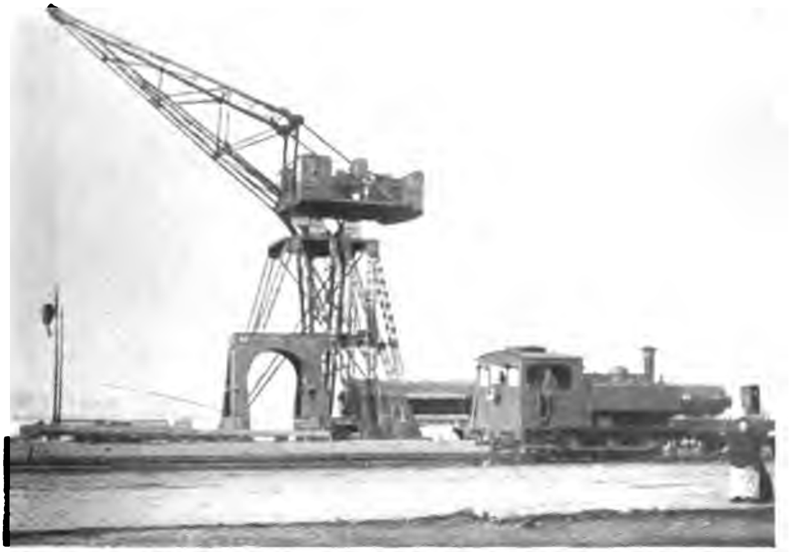
Finally comes the scheme known as 'Grande Coupure' which would change the course of the Scheldt down stream from Antwerp; by it the present winding waterway would be replaced by a much straighter channel."

The "Grande Coupure" or "great cut", provides for cutting a new channel for the Scheldt River across a great bend just below the City. This plan would add a new River Quayage of 28,536 feet to the present River Quayage of 18,040 feet. The new docks will increase the present area, which has taken a half-century to build, by 300 per cent. and increase the quayage from 10 to 31 miles, and all of this work is to be carried out within ten years. After this work is finished, the old bed of the Scheldt, about 2 square miles, is to be converted into a great basin by means of dams, locks, gates, etc.

In view of such wonderful foresight and confidence in the future of the Port of Antwerp, is it surprising that those in charge of the development and management of rival Continental Ports should view such great extensions with more or less anxiety for the future commercial supremacy of the North Sea Ports?



View of Half-Arch Cranes on the South Quays.



Fifty Ton Electric Hoisting Crane on the South Quays.

Cranes on the Campine Dock.

Government Bonded Warehouse.

THE PORT OF ROTTERDAM.

The Port of Rotterdam, although comparatively young is one of the most interesting and progressive of the Continental Ports; a keen rival of Antwerp for third place in the mad race for the commercial supremacy of Central Europe.

This port has been developed largely during the last half-century. It is wholly a municipal undertaking, and no State or Provincial aid has been asked or received in the construction of its great system of quays and harbors.

Rotterdam occupies a most favorable location for the development of a modern port. It is situated on the northerly bank of the River Maas, the principal and natural outlet of the great Rhine District. Previous to 1863, navigation between Rotterdam and the sea, a distance of about 18 miles, was most difficult, frequently taking steamers several days to make the journey. This was largely due to the shallowness and irregularity of the channel, but even then, with boats drawing but 10 feet of water the voyage was made during flood tides with no great difficulty. With the development of larger vessels, however, Rotterdam at once realized that unless provision was made for a straighter, wider and deeper channel to the sea, her growth and standing as a port would be greatly handicapped. A new channel was then decided upon and built from Vlaardingen to the North Sea, a distance of 14 miles piercing the Hook of Holland. This channel was completed in 1896 at a cost of $9,000,000. The City of Rotterdam paid about 10 per cent. of the cost and the Government the balance. The depth of water in the new channel is 27 feet at low, and between 32 and 33 at high tides, so that the largest sea-going vessels can now make the trip from the North Sea to Rotterdam in about 2 hours, where it formerly took several days.

Rotterdam is especially fortunate that the range in the tide levels (about 5 feet) was not enough to require the construction of locks and gates in the new channel. With them the passage of the present 60 or more sea-going vessels in and out at the Hook daily, would have been greatly hampered.

The Government controls the river through an agreement between the adjacent states, and no dues can be levied against vessels moored in the river and not touching at the quays or harbors. Below the Williams Bridge, 62 buoys, accommodating 32 sea-going ships at the same time, have been provided, the distances between the buoys varying from 180 to 420 feet, and the depth of river at the buoys from 20 to 28 feet.

The new Meuse River passing through Rotterdam forms one large basin with the harbors constructed on either side. Starting from the easterly part of the town and working toward the North Sea, the location, size and use of the quays and harbors as given by Consul-General Soren Listoe, is as follows:

QUAYS.

Maas Station Quay	1,650 feet long.
East Quay	1,200 " "
Boomjes	3,150 " "
Willemskade	1,730 " "
Westerkade	1,200 " "
Parkkade	1,700 " "
Quay between Park Harbor and Saint Job Harbor .	550 " "
Lloyd Quay	1,800 " "

At the latter quays the depth of water is 28 feet, while at the former six, the depth varies from 17 to 23 feet.

HARBORS.

Boerengat	3,850	ft.	long	and	from 60 to 120	ft. wide
New Haven	1,650	"	"	"	130	ft. wide
Haringvliet	1,350	"	"	"	200	" "
Old Haven	900	"	"	"	240	" "
Kolk	400	"	"	"	120	" "
Steiger	950	"	"	"	50	" "
Groenedaal	1,700	"	"	"	50	" "
Blaak	450	"	"	"	180	" "
Wynhaven	2,000	"	"	"	150	" "
Scheepmakershaven	2,650	"	"	"	150	" "
Leuvehaven	2,900	"	"	"	220	" "
Zalmhaven	1,000	"	"	"	400	" "

These harbors have a depth; varying from 5 to 12 feet and are chiefly used by the numerous market and inland craft; especially on Sunday, Monday and Tuesday of every week these harbors are overcrowded with the former type of Dutch vessels. As most of the connecting bridges are movable, all of these harbors can be reached by vessels without lowering their masts.

Kleine Veerhaven 200 feet long, 60 feet wide.

Veerhaven, 650 feet long, 240 feet wide, depth 17 feet at low water.

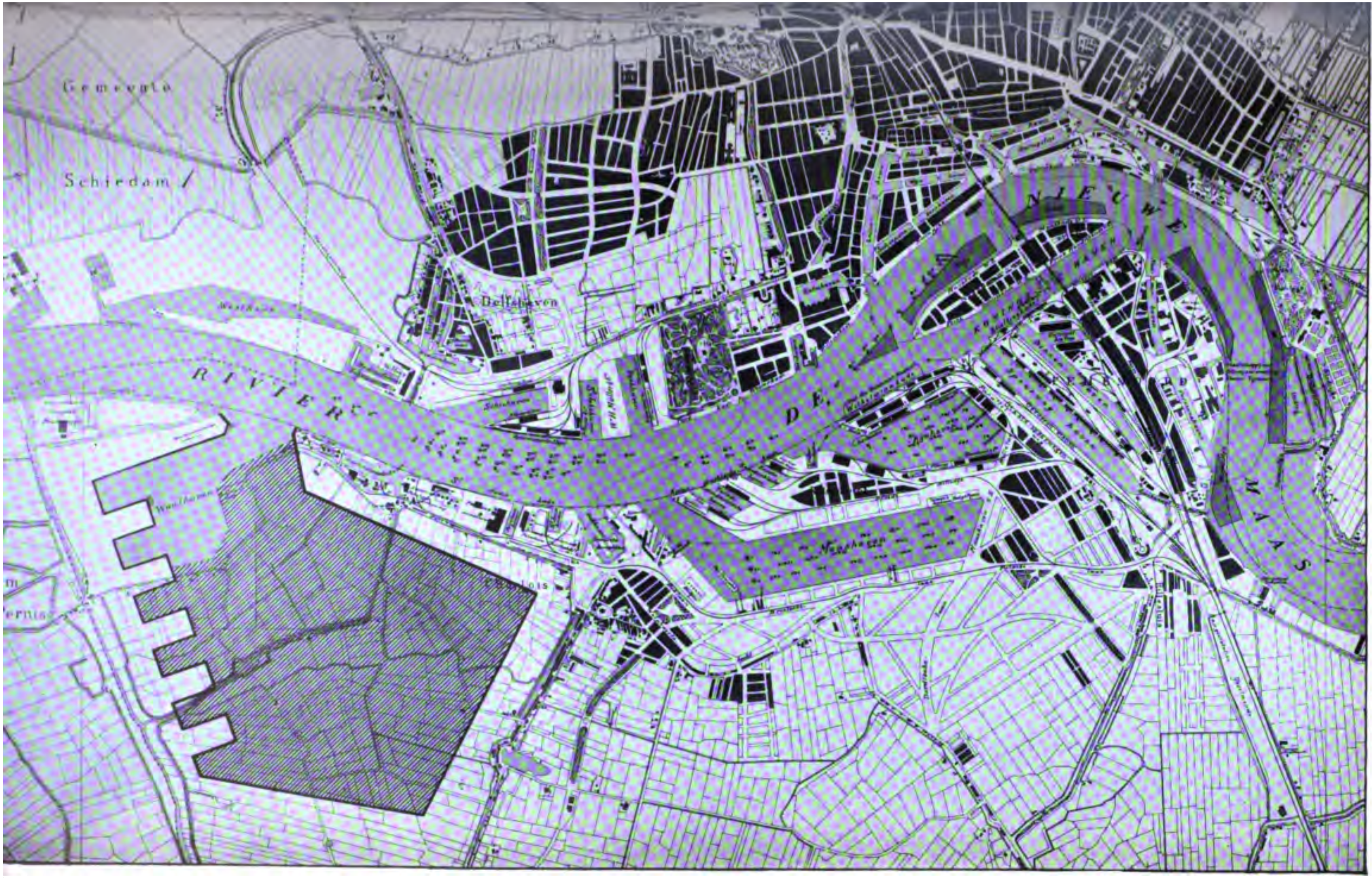
Park Harbor 1,500 feet x 26 feet.

St. Jobs Harbor 1,200 feet x 330 feet x 28 feet.

Schie Harbor, 1,850 feet x 400 feet x 28 feet.

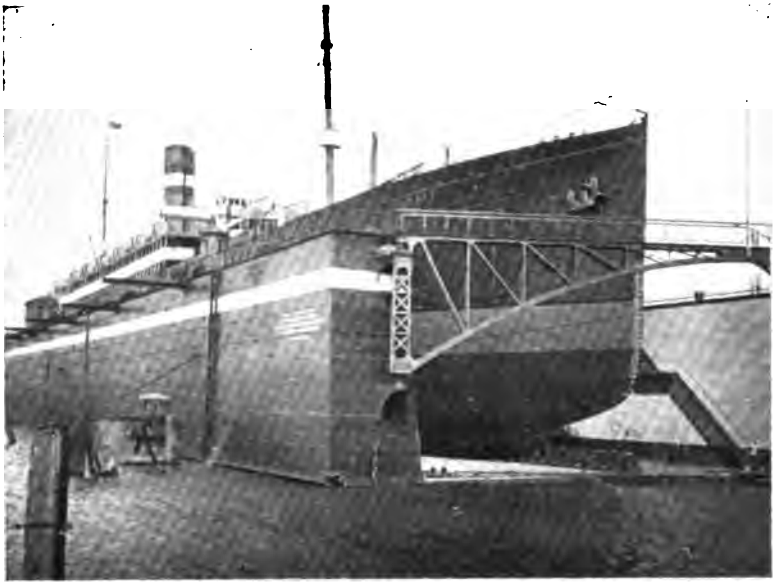
The three last named harbors are used principally for berths of the regular trade lines to different parts of the world.

The mouth of the river Schie leads into:



Plan of the Port of Rotterdam.

New "Waal" Harbor, area 800 acres, now being built is shown by cross-sectioned area in lower left-hand corner.



View of Ryndam of the Holland-American Line in Floating Dry Dock.

View of Ryndam of the Holland-American Line in Floating Dry Dock.

Middenkous,	1700 ft. x 220 ft. x 20 ft.
Voorhaven,	1300 ft. x 120 ft. x 10 ft.
Achterhaven,	950 ft. x 170 ft. x 16 ft.
Buizenwaal,	350 ft. x 260 ft. x 7 ft.

These last five harbors are situated at the ancient town of Delfhaven, since 1885 annexed to Rotterdam, and generally used for vessels temporarily laid up.

QUAYS ALONG THE NOORDER EILAND.

Maas Quay, east side 1,900 feet long, 10 feet deep, for steamers going up the river and to the interior places of Holland, towards the east.

Maas Quay, west side, 2,000 feet long, 10 feet deep, for steamers going down the river and to the interior towards the west.

Prins Hendrik Quay, East Side, 1700 ft. x 18 ft.

Prins Hendrik Quay, West Side, 2700 ft. x 20 ft.

The latter two accommodating passenger and freight steamers to Belgium and Germany, and also large Rhine craft and small sea-going vessels.

QUAYS ALONG THE LEFT BANK OF THE RIVER.

Feyenoord Quay 1,000 feet long and 12 feet deep facilitates the approach of Rhine craft which usually lie anchored in the river in front of this quay.

Nassau Quay 2,050 feet in length by 20 feet depth used by regular service up the Rhine and by small sea-going vessels.

Stieltjes Quay, East side 700 feet long by 20 feet deep.

Stieltjes Quay, West side 400 feet long by 21 feet deep.

both berthing regular traders to England.

Wilhelmina Quay 2,800 feet long by 28 feet deep where the Holland-American line has its wharf.

Katendrecht Quay,	1400 ft. x 27 ft. deep
Charlois Quay,	670 " " 27 " "
St. Jan's Quay,	2800 " " 23 " "

upon which are built the tanks of the different Petroleum Companies; this quay is not provided with walls, but wooden landing stages and the necessary duc d'alves facilitate the mooring of tank steamers

Kortennoord Quay 1,100 feet long by 25 feet deep wholly in the employ of the Royal Society for the Exploration of Petroleum Wells in the Dutch East Indies, which Company also has an oil refinery at this wharf.

HARBORS ON THE LEFT BANK OF THE RIVER MAAS.

Nassau Harbor	2,000	ft.	long,	260	ft.	wide	&	15	ft.	deep.
Persoons Harbor	1,900	"	"	200	"	"	"	12	"	"
Binnen Harbor	3,400	"	"	260	"	"	"	24	"	"
Entrepot Harbor	700	"	"	200	"	"	"	22	"	"

This latter is a bonded warehouse harbor and its entrance from the Binnen Haven is barred by a heavy log; in this harbor and along its quay dutiable merchandise may be handled free of tax.

Spoorweg Harbor 4,000 feet long x 400 feet wide and 25 feet deep.

The freight department of the Netherlands State Railways is located here.

Rhine Harbor 29 feet deep and covering an area of 75 acres; its entrance is 500 feet wide and its width increases to 1,500 feet towards the end; it contains 19 mooring posts where 15 large ocean ships can be berthed and discharge their cargo on both sides into lighters and smaller vessels. The lineal quayage around this harbor is 7,000 feet.

Katendrecht Harbor 600 feet long, 350 feet wide, 23 feet deep.

Second Katendrecht Harbor 850 feet long, 450 feet wide, 27 feet deep.

Maas Harbor 1,100 feet wide, covering an area of 150 acres; depth 28 feet with 25 mooring posts accommodating 22 large sea-going steamers.

This harbor is thus far not provided with quays, but is protected by stone slopes constructed upon wicker foundations which will permit the construction of quays when the necessity becomes apparent.

Dock Harbor 1,100 feet long, 500 feet wide and 37 feet deep; as its name intimates, this harbor is occupied by the three smaller city dry docks.

St. Jan's Harbor	400 ft.	x	200 ft.	x	10 ft.
Petroleum Harbor	550 ft.	x	200 ft.	x	20 ft.
Kortenoord Harbor	1,100 ft.	x	240 ft.	x	25 ft.

These latter three are all occupied by the different Petroleum Companies for their re-shipment of oil into the interior of Holland and Germany.

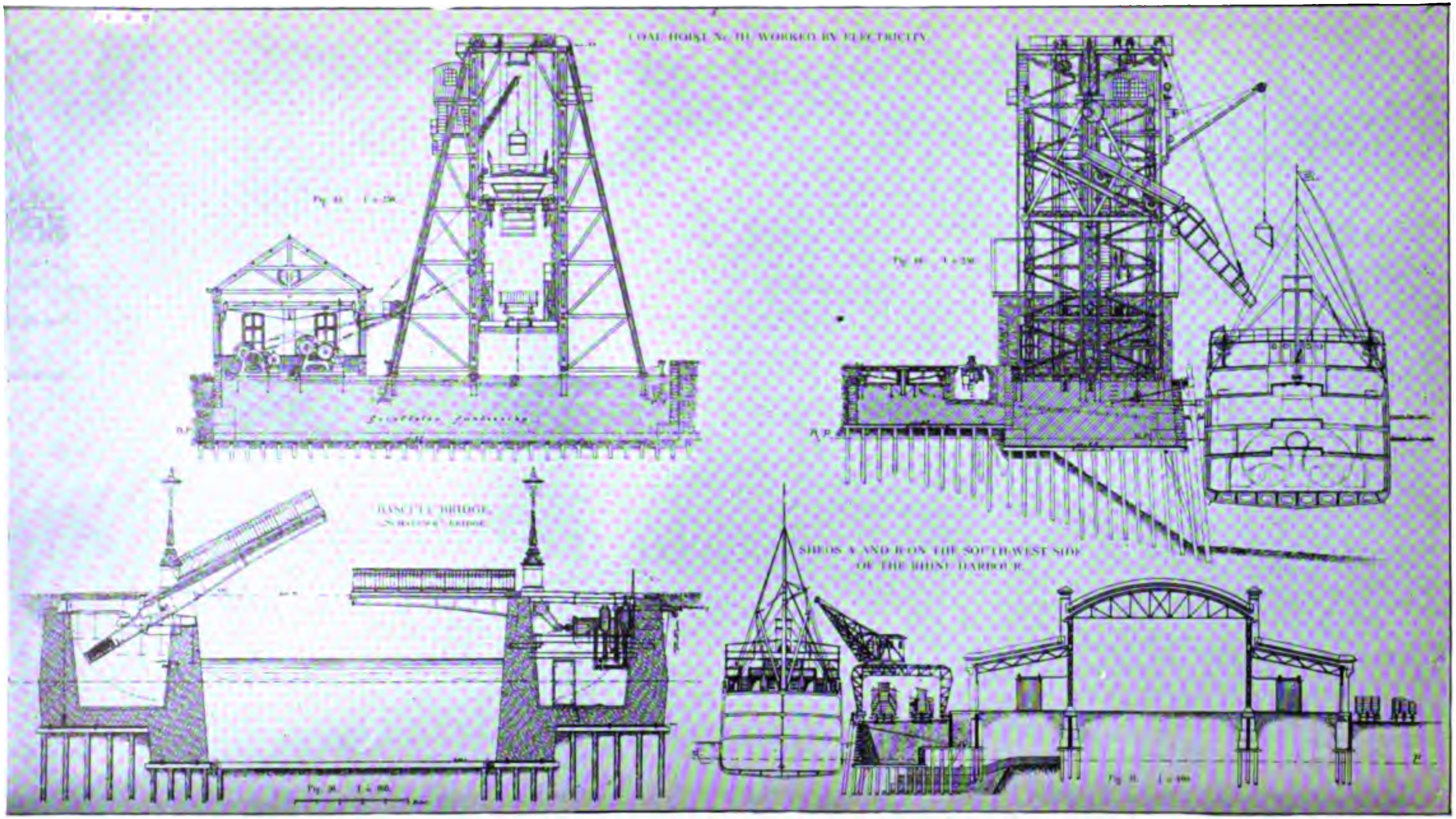
Waal Harbor. This is the basin which is now in course of construction, and when finished will cover an area of eight hundred acres; thus far about 65 acres have been dredged out, but the work is steadily progressing, and it is confidently expected that this harbor will be completed and placed at the disposal of shipping in the course of next year."

To show how difficulties are overcome in the determination of the Rotterdam officials to develop one of the foremost ports of the world, it is worthy of note that in the construction of the Maas Harbour it was necessary to demolish a church, a school-house, and 700 homes. The area of this harbor is 150 acres. It was commenced in 1897 and completed in 1905.

The present area of the Rotterdam harbors, exclusive of the River and

Mooring Pier in Rotterdam Harbour.

Ocean-going Vessels Loading and Unloading in Midstream.



COAL HOIST No. III WORKED BY ELECTRICITY
BASCULE BRIDGE
SHEDS A AND B ON THE SOUTH-WEST SIDE OF THE RHINE HARBOUR

The Port of Rotterdam.
Electrical coal hoist, Bascule Bridge, and cross-section of sheds on the southwest side of the Rhine Harbor.

Konings Harbor, which together form one large basin, is about 500 acres, and the length of walled quays, 20 miles, and of those not walled, 7 miles.

The construction of the Waal Harbor, now underway, well illustrates the confidence the people of Rotterdam have in the future of their port. Its area, 800 acres, is over five times the size of the Maas Harbor, the last one built, and almost twice as large as the present total harbor area of the city which has taken about a half-century to complete.

While the quays on the northerly side of the river have but two old style cranes, the new quays and harbors on the opposite side of the river are completely equipped with every conceivable mechanical device; fixed and movable electric, steam, and hydraulic cranes of varying lifting power, and floating cranes, derrick cranes, grain elevators, coal hoisting apparatus, etc.

The Rotterdam port is poorly supplied with warehouse facilities, there being but one on the water's edge. This is perhaps largely due to the old prevailing custom of storing goods in the lower part of the merchant's private houses which are especially built for this purpose.

"These are the four kinds of bonded warehouses in Rotterdam, subdivided according to the control exercised by the custom-house authorities:

1. The Free Bonded Warehouse.
2. Private Bonded Warehouses.
3. Fictitious Bonded Warehouses.
4. Warehouses, not controlled by the custom-house authorities.

The free bonded warehouse is an institution managed for the account of the municipality under the supervision of a Board of Control, some members of which are appointed by the Queen. The custom-house authorities keep constant watch over these bonded warehouses. The free bonded warehouse has two establishments, and the custom-house authorities superintend the carrying of dutiable goods to these bonded warehouses. The duties need only be paid when the goods leave these establishments.

The private free bonded warehouses are intended for goods liable to a high excise duty, such as spirits, wine, etc. These warehouses are in private hands but are entirely under the control of the customs, so that they must be built in accordance with their regulations, and nothing can be either stored or cleared without their co-operation.

The fictitious bonded warehouses are for goods liable to low duties, such as petroleum, cottonseed, tobacco, mineral waters, etc. The custom-house authorities confine themselves to controlling the quantities stored from time to time. These warehouses, therefore, possess the same advantages as the other kinds without their drawbacks as regards continual supervision.

Warehouses not controlled by the custom-house authorities, therefore contain either goods that come in free, or goods the duties on which have been paid."

The Harbor of Rotterdam is provided with seven fire floats which are ready at a moment's notice during the daytime, and two of the steam floats are always patrolling the harbors at night for the extinguishment of fires.

The policing of the harbors is in charge of a special division of the municipal police force, consisting of one inspector, two deputy inspectors, and thirteen constables. They are provided with a fast electric patrol boat equipped with a powerful searchlight. This force is a powerful agency for the maintenance of order and the prevention of theft and crime in the harbor. A force of mounted men regulates traffic and preserves order on the quays and bridges. Because of the numerous canals, basins and harbors right in the heart of the city, many bridges are necessary, and all have to be of the movable type to permit of the passage of vessels. These bridges are usually considerably narrower than the adjacent highways, and vehicular traffic becomes greatly congested if the bridges are open for any length of time.

The tops of the quay walls of the smaller harbors in the heart of the city are usually about four feet above the water level, and a row of Rhine boats lined up at one of these quays, with the sale and trading of farm and dairying produce by people from the interior towns of Holland, presents a most interesting sight.

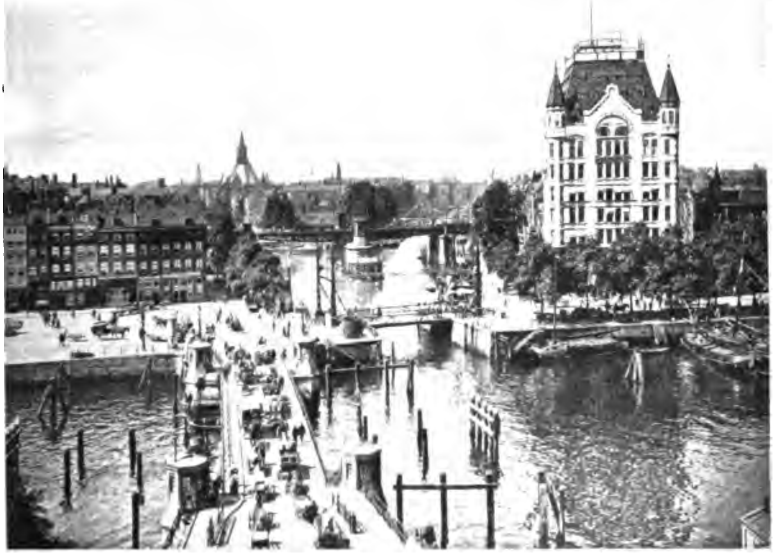
These quays are usually surrounded by tree-lined city streets, and the harbors are as much a part of the city growth and development as the streets are to American cities.

Rotterdam is probably better supplied with tug boats than almost any other European port, there being no less than 350 owned by various local firms.

The following table showing the number of inward-bound vessels, cleared in at Rotterdam, as compared with other ports in the Kingdom, since 1850, well illustrates the rapid growth of the port:

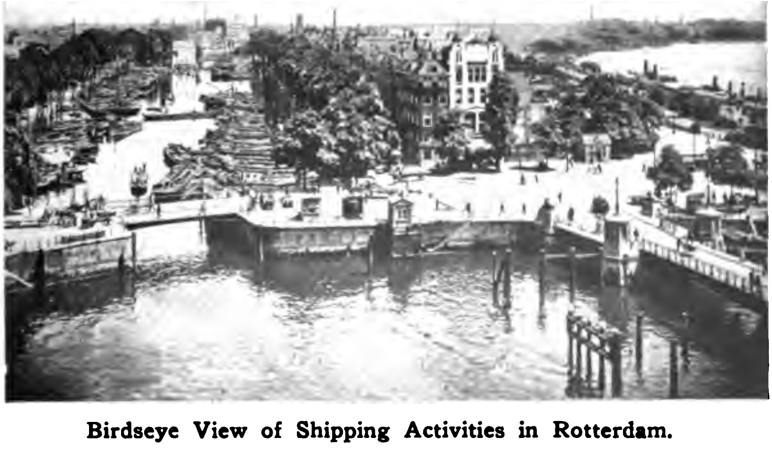
Growth of the Port,					Percentage of Ships	
Year	For the entire Kingdom		For Rotterdam		For Rotterdam	
	No. of Vessels	Tonnage in net. Reg. tons.	No. of Vessels.	Tonnage in Net. reg. tons	No. of Vessels	Tonnage
1850	6961	967,710	1940	346,186	27.9	35.5
1860	8217	1,591,419	2449	673,839	29.8	42.4
1870	8351	2,037,491	2973	1,026,348	35.6	50.1
1880	8164	3,438,038	3456	1,681,650	42.3	48.9
1890	9475	5,446,158	4535	2,918,425	48.2	53.6
1900	12307	9,450,710	7268	6,326,901	59.0	64.9
1907	14404	13,791,464	9221	10,107,155	64.0	73.3

The increasing importance of Rotterdam as the principal port of the rich Rhine Valley is shown by the following table giving the traffic up the Rhine from Amsterdam, Rotterdam and Belgium, during the last fifteen years, in metric tons:



View in Heart of Rotterdam.

Showing several bridges, building on right "White House"—only skyscraper in city.



Birdseye View of Shipping Activities in Rotterdam.

Interesting View in Rotterdam Harbour.

Interesting View in Heart of Rotterdam.

Year,	Amsterdam, Tons	Rotterdam, Tons,	Belgium Tons
1890	170,365	2,582,791	1,165,457
1895	242,315	3,980,127	1,571,765
1900	446,837	7,845,544	2,604,632
1901	435,838	7,735,307	2,757,330
1902	451,936	8,197,989	3,238,843
	Increase	Increase	Increase
	1:3.51	1:5.71	1:4.23
1903	437,730	10,338,291	3,786,569
1904	428,859	10,684,261	4,104,306
1905	478,920	12,771,307	4,435,580
1906	538,945	13,357,575	4,821,229
1907	597,518	14,762,226	4,937,737

Over 80 per cent. of the traffic down the Rhine is diverted to Rotterdam.

Rotterdam has a total of about 100 regular lines of steamers departing for various parts of the world on regular sailing days. The principal one of these is the well-known Holland-American line with its large fleet of passenger and freight steamers. Every week steamers of this line leave Rotterdam and New York.

While no unusual difficulty is encountered in maintaining the requisite depth in the channel and harbors, Rotterdam maintains a fleet of dredges which are usually busy on maintenance or new work and in keeping the channels free from ice during the winter season. The material dredged is mostly used for filling and raising low ground, some of it being pressed through pipes by sand suckers, nearly two miles.

Owing to the treacherous mud and sand sub-soil in and around Rotterdam, much difficulty has been experienced in building permanent and durable quays, and many failures have been recorded during the last half-century.

The growth of the city of Rotterdam has been as phenomenal as that of its port. Since 1850 it has grown from a comparatively small city of 90,000 people, to over 400,000 in 1908.

The increase in the population of the five largest Dutch Communes in 1900 and 1907, is as follows:

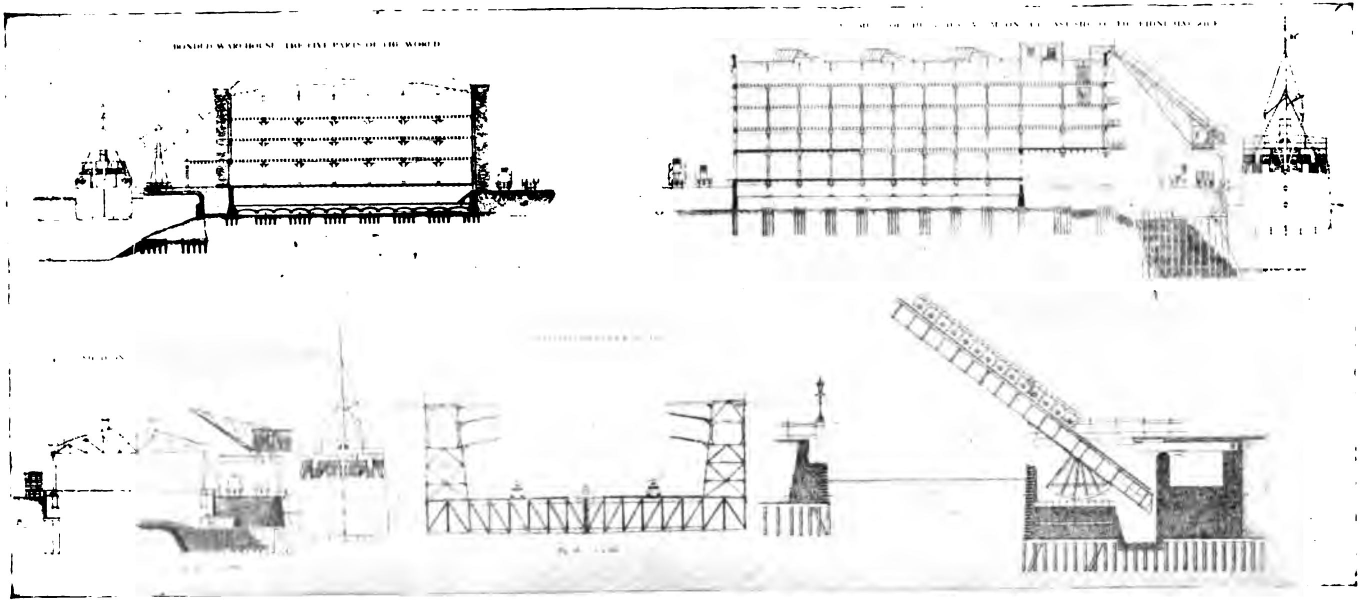
	Population Jan. 1, 1900	Population Jan. 1, 1907	Percentage Increase.
Amsterdam,	510,853	564,186	10.4%
Rotterdam,	318,507	390,364	25.7%
The Hague,	206,022	248,995	20.8%
Utrecht,	102,086	114,692	12.3%
Groningen,	66,537	73,278	10. %

Between 1850 and 1907 Rotterdam's percentage share in the increase in the population for the whole country (The Netherlands) has grown from 6.4 to 14.0 per cent. and the percentage of the population of Rotterdam to that of the whole country has increased from 3.2 to 6.9 per cent.

To show how water transportation dominates the situation, it is said that the railroads handle but ten and the rivers and canals 90 per cent. of the commerce at Rotterdam.

Since 1870 the City of Rotterdam alone has spent over $20,000,000 upon her harbor system, and $9,000,000 upon the new ship canal to the North Sea, making a total investment of about $30,000,000.

The harbor system of Rotterdam is under the control of the "Municipal Board of Works", a select committee of six Common Council men, with an Alderman as Chairman. The principal adviser of this Board is the "Director of the Municipal Works", who has as a permanent official staff, a deputy-director, two assistant managers, three engineer-architects, thirteen chief-surveyors, fourteen surveyors and architectural designers, and a temporary staff of five engineers, one architect, three chief-surveyors, and two hundred and thirty surveyors, designers, assistant-surveyors, and foremen. Under this staff there are regularly employed about 1,550 laborers. This department is managed no differently from the other municipal departments, for the Director of the Municipal Works, in addition to his duties in connection with the great dock system, has charge of the water, gas, and electrical works, the municipal telephone, and the abattoir.



The Port of Rotterdam.
Cross-section of three typical sheds; floating dry dock; and rolling Bascule Bridge.

The Canals in Rotterdam
Serve the dwellings as much as the city streets.

Interesting View in the Heart of Rotterdam.

THE PORT OF AMSTERDAM.

While the Port of Amsterdam is not in the same class with that of her ambitious young rival, Rotterdam, and other continental ports, it seems highly desirable to describe what has been accomplished in an endeavor to maintain the former prestige of Amsterdam as the "Princess of the Sea", by the construction of great sea canals and the influence these have had upon her subsequent development.

Amsterdam at one time enjoyed the distinction of being the first commercial town of the Republic and her ships were known throughout the world. This era of prosperity was followed, however, by a decline during which time other continental ports were making remarkable progress.

Amsterdam is so located that entrance to her port, previous to the construction of deep sea outlets, was through the Zuyder Zee, a long, roundabout way which answered the purpose until the type of vessels changed from light sailing craft to larger steam-propelled vessels.

As the navigation facilities of Amsterdam were then seen to be insufficient for the rapidly increasing demands of commerce, bold schemes were conceived and carried out in an endeavor to meet the new requirements, and for the purpose of maintaining the prestige of Amsterdam as one of the important continental ports.

The first plan to obtain better access to the North Sea led to the construction of the Great North Holland Canal in 1818-1825 with an outlet at Nieuwediep. This canal was 50 miles long, but only partially accomplished its purpose, owing to the limited dimensions, its many bends, and the fact that it was too long and roundabout a way to reach Amsterdam. As a main line for through business, this canal now is very little used.

Then followed the construction of the North Sea Canal leading directly from Amsterdam westerly to the North Sea at Ymuiden. This canal is about 15 miles in length and was originally 23 feet in depth, but this dimension has since been increased to about 30 feet. Until the completion of the Panama Canal this canal of Amsterdam is the largest artificial sea route in the world, as the following table, giving dimensions of several well-known canals well illustrates:

	Bottom Width	Depth below low Water	Slopes	Width at water level	Contents of wet Profile
North Sea Canal,	50 M	9.8 M	3:1	120 M	770 M
Canal from Ghent to Terneuzen,	24 "	8.75 "	3:1	50 "	440 "
Manchester Canal,	36.6 "	7.93 "	1½:1	60 "	385 "
Kaiser Wilhelm Canal,	22 "	9 "	3 to 1½:1	67 "	413 "
Suez Canal,	33 "	9.50 "	2½:1	80.50	539 "

Suez Canal (after the improvements, partly under construction),	45 "	10.50 "	2½:1	97.50	748 "
Panama Canal (outside the Culebra Cut),	45.72	12.19 "	3:1	119 "	1003 "
Panama Canal (in the Culebra Cut),	60.96	12.19 "	Vertical	60.96	743 "

The Suez Canal and the Kaiser Wilhelm Canal are provided with "lay bys" where large vessels have to wait for each other, while on the North Sea Canal they can pass one another at any point. After the improvements are completed on the Suez Canal, the depth will exceed that of the North Sea Canal, but the contents of its wet profile will be less. The Panama Canal will also be deeper, and wider in the Culebra Cut, but the North Sea Canal can be still further deepened without great inconvenience or expense so that it will still be able to maintain a leading position among the principal artificial waterways of the world.

The westerly end of the North Sea Canal ends at Ymuiden on the shore of the North Sea where an artificial harbor of 40 acres has been created. Vessels pass into this harbor, where the force of the waves from the North Sea is considerably reduced, and then through substantially built locks and gates into the canal. Similar gates on the east side of Amsterdam shut out the waters of the Zuyder Zee, thus making the canal practically a tideless basin with a constant water level.

The North Sea Canal was built by the North Sea Canal Company with financial aid from the Government and the City of Amsterdam. The entire project has since been taken over by the Government and all harbor and canal dues have been abolished so that navigation on the canal is free. The total cost of the canal was about $12,000,000 and with the exception of two railway bridges crossing it, is maintained, lighted, buoyed and policed by the State.

"In order to satisfy the requirements of her constantly increasing shipping, Amsterdam now possesses, after the completion of these improvements, a short connection with the North Sea:

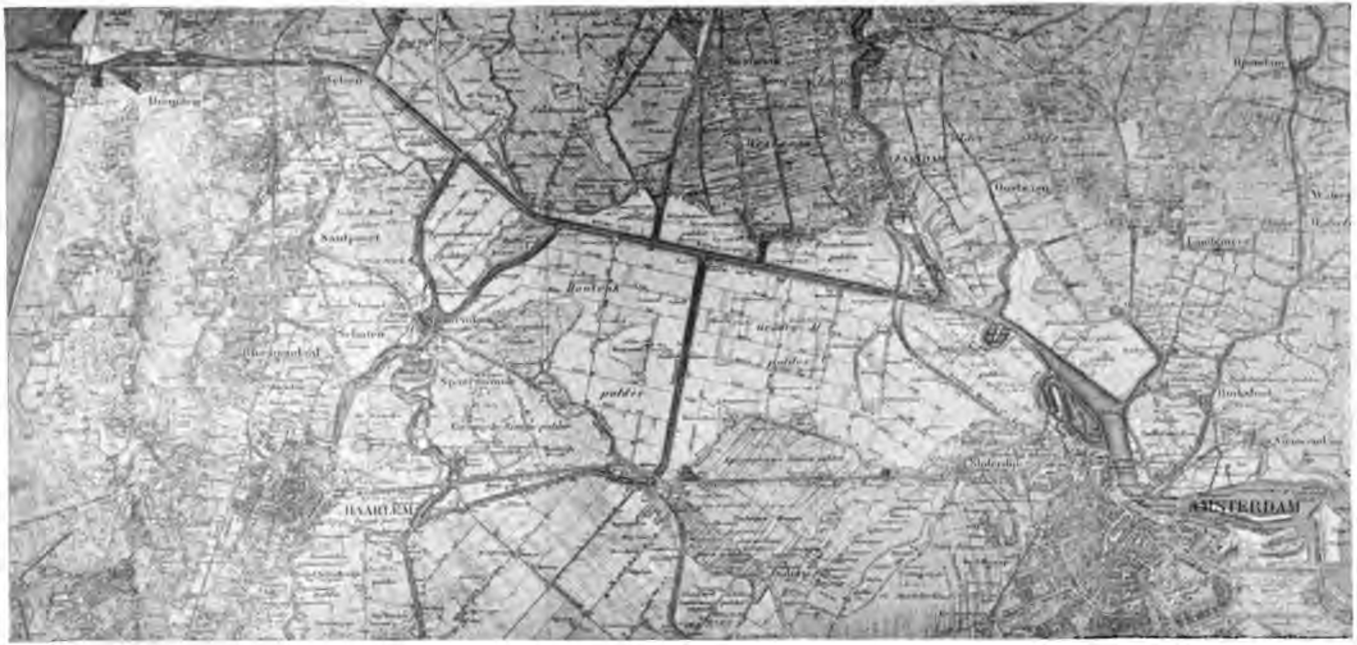
1. Of greater dimensions than any other canal for sea-going vessels, while from a technical point of view there are no serious difficulties in connection with further widening and deepening,

2. Admitting, at any time, also at ebb-tide in the North Sea, almost any vessels of the greatest dimensions,

3. Of a sufficient width to enable vessels of the greatest dimensions to pass each other at any point.

4. Spanned in only two places by bridges, which, however, owing to the width of their passages, cause the least possible inconvenience to navigation,

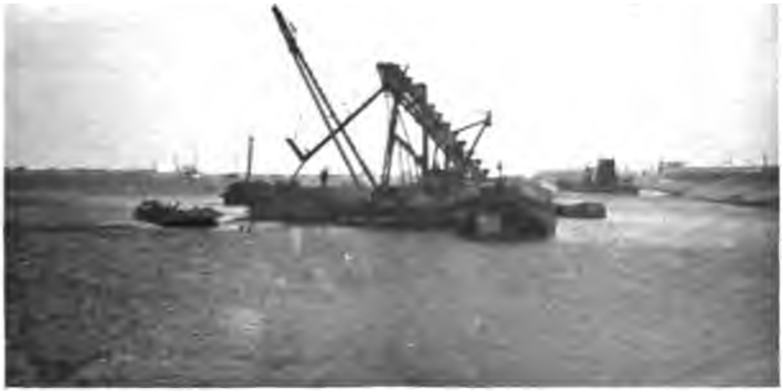
5. Navigable at night as well as in the daytime, by the lighting up of the channel, and in winter as well as in summer, the ice being cleared away, if necessary.



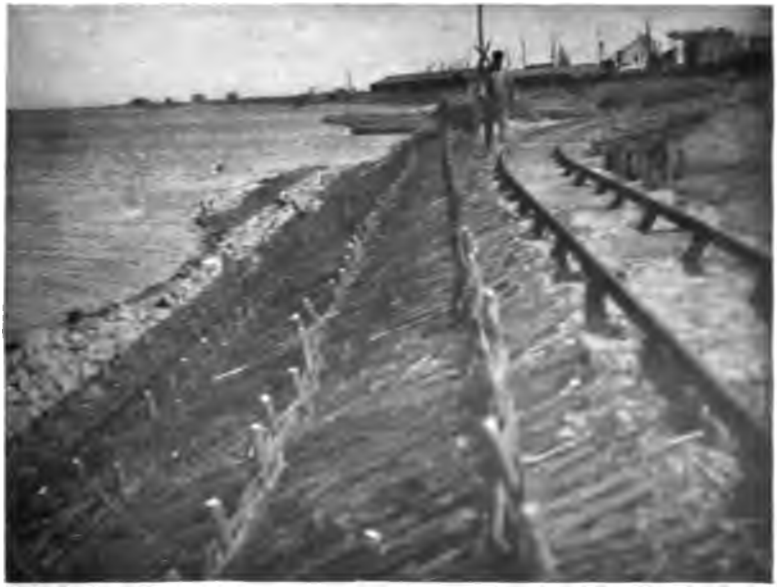
Plan showing the Great North Sea Canal from Amsterdam (lower right corner) to the North Sea at Ymuiden (upper left corner), 15 miles in length and completed in 1876 at a cost of $12,000,000.

View of the Hem Bridge spanning the Great North Sea Canal—the largest swing bridge in Europe, opened and closed by hydraulic power in from 4 to 5 minutes.

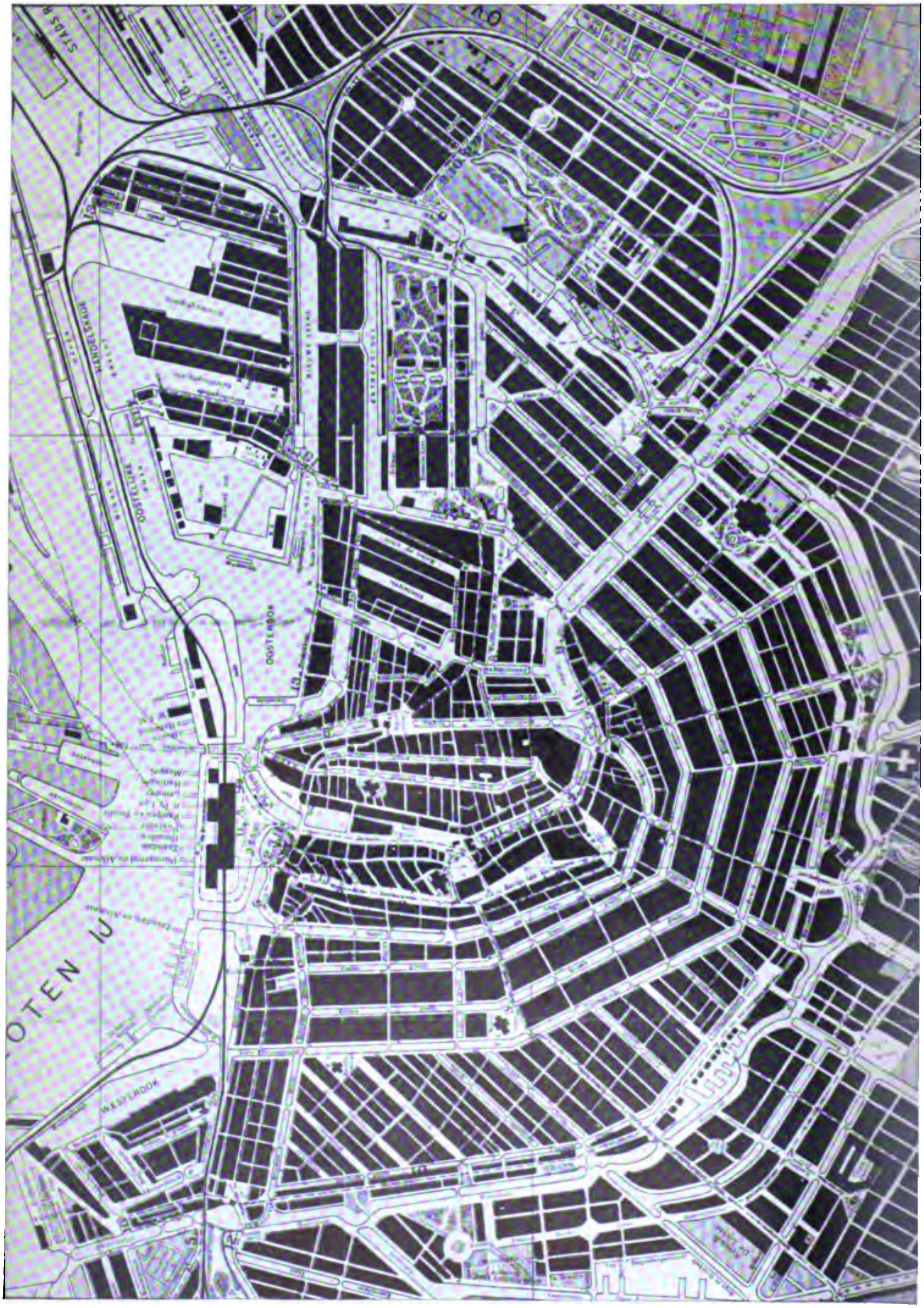
View of the Y Before Amsterdam.



View of Dredger at Work on New Dock.



View of dyke formed by dredging, with slopes protected by mattresses preparatory to construction of new dock and quays.



Plan of the Port of Amsterdam. (On left.)

The concentric semi-circles (in light tint) show the numerous canals throughout the city. Usually there are tree-lined roadways on each side of these canals.

6. Provided with well-arranged pilotage and towage services, and free of dues."

Since the opening of the North Sea Canal, the commerce passing through it has increased regularly and rapidly. In 1877 the tonnage of sea vessels in both directions was 1,376,781. In 1906 the amount had increased to 6,683,502 tons or five times what it was the first year after the canal was opened, and the increase of small vessels was even greater, as shown by the following table:

SHIPPING TRAFFIC THROUGH THE NORTH SEA LOCKS.

Number and tonnage of the vessels locked in both directions.

Sea-Going Vessels, Fishing and other small Crafts.

Year	Number	Registered tons	Number
1877	2,445	1,376,781	931
1887	3,323	2,866,106	2,933
1897	4,723	4,900,875	4,739
1906	4,579	6,683,502	21,325

While the larger portion of the commerce of the Port of Amsterdam passes over the North Sea Canal, a large amount of business is done with the Northern, Eastern and Southern provinces. More than 67,000 vessels, passed through the Oranje Locks in 1906, this amount representing the traffic by water to the Northern and Eastern provinces maintained across the Zuyder Zee.

The principal connection with the South and Germany is by means of the Merwede Canal completed in 1892 at a cost of $4,000,000 and navigable for the largest Rhine ships.

The influence which this canal has upon the Port of Amsterdam is shown by the following statistics giving the traffic through the lock at Zeeburg (Merwede Canal):

Year	Number of Vessels	Tonnage
1896	37,283	3,462,778
1897	37,100	3,671,946
1898	40,145	4,400,095
1899	36,722	4,433,357
1900	44,155	4,737,320
1901	47,027	5,030,434
1902	48,521	5,363,111
1903	50,251	5,664,996
1904	50,477	5,922,357
1905	51,073	6,021,125
1906	54,415	6,523,713

Between 1899 and 1906 the number of Rhine ships arriving at Amsterdam through the Merwede Canal increased from 583 to 751.

The Port of Amsterdam is well supplied with modern docks largely developed within the last 25 years and wholly by the municipality. These have been planned and carried out to meet the growing demands of navigation, and all are well equipped with mechanical appliances for loading and unloading vessels quickly and economically. There are besides, ample railway connections, splendid warehouses, dry docks, ship building plants, public commercial and navigation schools, etc., in fact, about everything necessary to develop and maintain a modern port. The port contains 10 miles of quayage and nearly 20 miles of railroad around the docks.

The amount expended by the town since 1875 for the benefit of the various branches of navigation, exceeds 12 million dollars. There are 17 regular steamship lines sailing from Amsterdam fortnightly; three every 21 or 28 days; fourteen weekly, and seven from two to four times each week.

The canal system of the City of Amsterdam is most interesting. The tree-lined streets and canals are laid out in concentric circles around the "Dam" and railroad station as a centre, and the canals are so numerous that it is said that 300 bridges are required to carry the city streets over them, hence the title "The City of many Bridges."

One cannot but admire the bold measures which have been adopted and successfully carried out by Amsterdam, the capital and largest city of Holland, to maintain her prestige among the leading Continental Ports.

View of Floating Buoy on North Sea Canal.

View of Commercial Quay.

Royal Netherlands Steamship Company.

View of Six-story Fireproof Municipal Bonded Warehouse.

THE PORT OF HAMBURG.*

"Few ports in the world, if any, are equipped to handle merchandise more expeditiously and economically than Hamburg, and this in spite of a situation 75 nautical miles from the open sea. For many centuries the local government has made its first concern that of keeping its port facilities abreast of the commercial requirements of the times, and in so doing has even assumed the responsibility and the cost of dredging and lighting the entire lower Elbe, although only a portion of its shores are within the territory of this State.

The free city of Hamburg received a charter from Frederick Barbarossa on May 7, 1189, guaranteeing the right of free navigation on the lower Elbe, and upon this celebrated charter repose all subsequent claims to entire independence, which have been waived by the City only to the extent of enabling it to become a full and sovereign member of the Empire.

During the fleeting occupancy of Hamburg by Napoleon, he contemplated the strengthening of the commercial resources of the city by building a canal from Luebeck on the Baltic to the Elbe, and still other canals connecting also the Elbe, the Weser, the Ems, and the Rhein. All of these canals, with the exception of the one from the Rhein to the Ems, now form parts of the great interior navigation system of Germany, which, together with Hamburg's position on the North Sea, facilitate the carrying on of a great commerce with the whole of northern and central Europe of which this city is the center.

Upon the entrance of the State of Hamburg into the German customs union it became necessary to subject all goods entering the city for consumption to the payment of the same duties as were collected in other portions of the Empire. To accomplish this result, and at the same time to preserve for its growing trade the freedom of centuries, the most important section of the harbor was set off as an immense bonded warehouse within which goods might be landed, stored, manufactured, and re-exported subject to no custom control whatever. Within this zone, complete commercial freedom prevails, and it is only when goods from the Free Harbor pass the boundary line for immediate consumption that they become subject to the payment of German duties. Thus, Hamburg remains a protectionist city in its capacity as a member of the Empire, while preserving its status as a free city in respect to its extensive transit trade.

PORT CHARGES AND FACILITIES.

The maximum depth of water in the Hamburg Harbor is 25.82 at low water, and 32.8 feet at medium high water. The maximum draft of vessels at present is about 31.16 feet. At ordinary high tide steamers of any size may enter the port, including such as draw 30 feet.

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*From report made to the Dept. of Commerce and Labor, Washington, D. C. Oct. 28, 1910, by Consul-General Robert P. Skinner.

Numerous dry docks including one believed to be the largest in the world, patent slips, shipbuilding wharves and engine works enable shipowners to effect any repairs. The quays are provided with cranes lifting burdens up to 150 tons, loading and unloading machinery, railroad tracks, and other modern appliances for the quick discharge of cargoes. Harbors for river craft and convenient means of transferring cargoes from sea-going to river and coastwise vessels, exists now, and are being very greatly improved.

During the winter, powerful ice breakers keep the channel open so that ships are able at all times to proceed up and down the river.

Merchandise is loaded and discharged either alongside the quays or amidstream. In the former case, according to a tariff of quay dues referred to below.

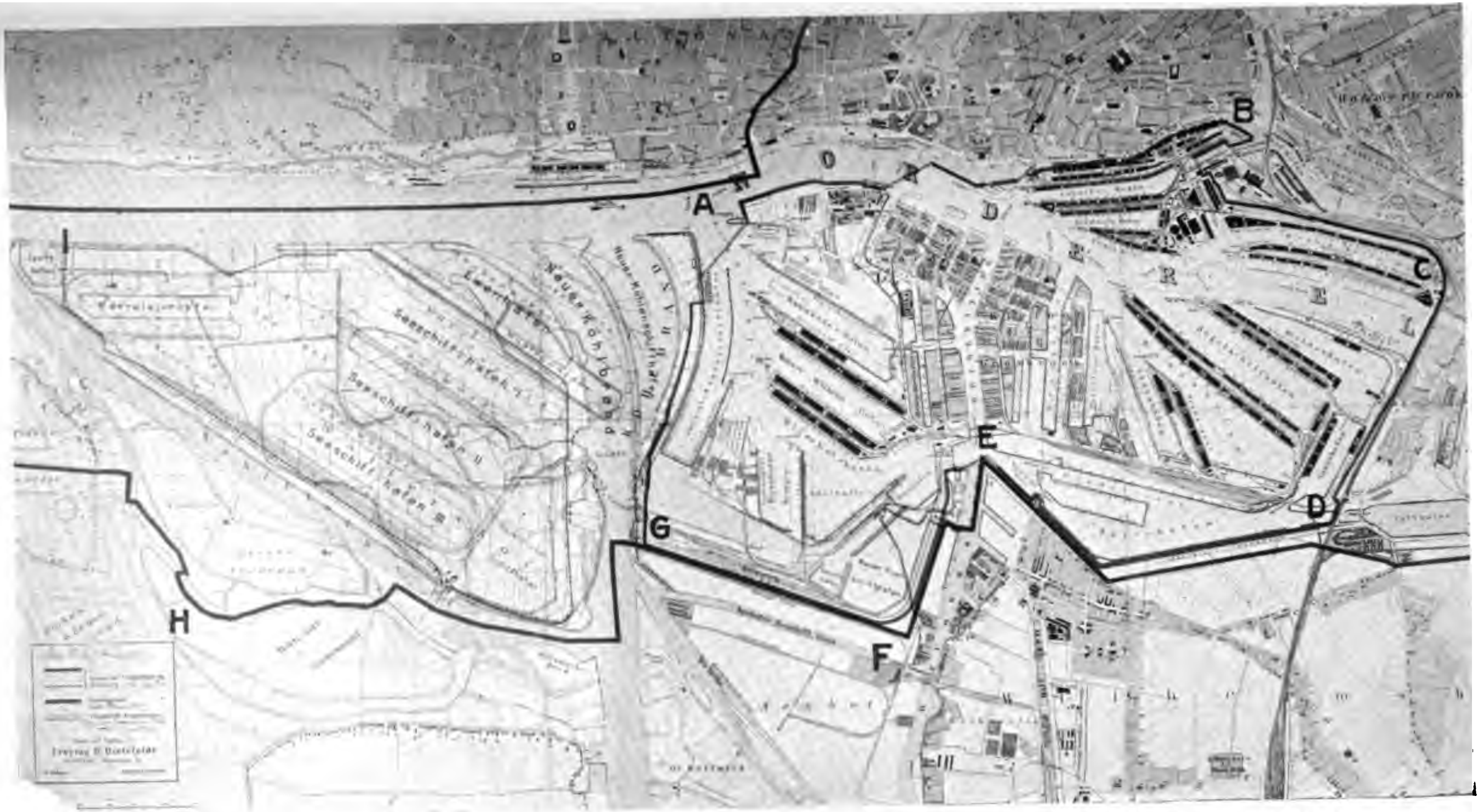
Bulk cargoes are always discharged and loaded in the river, whereas mixed cargoes are commonly discharged on the quay in order to obtain quick despatch. Steamers with general cargoes frequently discharge in the river also, but the operation is necessarily slower than when the vessels are alongside, owing to the necessity of assorting packages according to marks and numbers, and the shifting of lighters. When ships load from the quay side, the cargo is taken from the quay shed by the quay cranes and put into the ship; or vice versa; whereas, if the operation is performed in midstream, this work is performed by the ship's winches. For the discharge of loose grain there are ten floating pneumatic elevators which are capable of discharging from 700 to 800 tons per day per elevator out of one hatch. Thus, if four elevators are employed, 3,000 tons can be discharged in one day.

The expenses incurred by a vessel in the Hamburg Harbor depend upon the cargo, whether or not quays are used, and the private charges of various persons who furnish their personal services. The charges made by stevedores, barge owners, and shipbrokers, are charges of a private nature, in regard to which official information cannot be given. Tonnage dues are charged to all vessels, but quay dues only to those which discharge alongside the quays.

The auxiliary vessels for sea-going ships in use in the port of Hamburg can be divided into three classes:

1. Barges generally used for transportation of merchandise on inland waterways of from 300 to 1,800 tons loading capacity, used chiefly for the transportation of grain and bulk articles taken over directly out of the sea-going ship to all points on the upper Elbe and Bohemia. These barges are built flat, broad and long. Their draft is about 3.3 feet. Freights are charged according to offer and demand; they fluctuate considerably, being chiefly based on the Elbe water level, particularly on the upper Elbe. In severe winters, river traffic is interrupted on the upper Elbe by ice.

2. Iron lighters of from 180 to approximately 1,000 tons loading capacity with crews permanently living on board, and with loading appli-



Plan of the "Free Port" of Hamburg A, B, C, D, E, F, G. Proposed extension of the "Free Port" A, G, H, I.

Interesting View in Hamburg.

View of a Portion of the Free Port.

ances of their own—mast, lighter beam, and winch. These are used for the transportation of goods to all points along the lower Elbe and the Baltic, by means of tow boats. In view of the fact that the lower Elbe (below Hamburg) has been improved by dredging so that vessels drawing more than 30 feet of water can reach the Port of Hamburg without being obliged to lighter previously, it seldom happens nowadays that vessels lighter part of their cargo at Brunshausen, the most favorable lightering point on the lower Elbe.

3. Steel barges, covered for the transportation of goods from ship or dock to warehouse or factory, are employed under a very complicated tariff.

Steamers arriving with cargoes of grain discharge exclusively by means of floating elevators, directly into barges lying alongside, generally amidstream. Resin, turpentine and cotton steamers also discharge almost exclusively amidstream, directly into harbor or river craft, chiefly because of the danger of fire. Vessels arriving with general merchandise from New York, Montreal, and other United States and Canadian Ports, discharge their cargoes almost exclusively upon the docks (quays). The consignee of the goods may either forward such merchandise by rail, lighter or river craft. Smaller quantities are removed from the quays by carts and transported to the place of destination.

In the harbor of Hamburg there is maintained an extensive service of lighters and harbor barges. There are about 500 covered and 2,500 open barges, total, 3,000 vessels, available, ranging from 20 to 500 tons loading capacity.

THE HAMBURG FREE PORT AND WAREHOUSE.

The Free Port of Hamburg is, within itself, a city. It comprises, as already explained, that portion of the city within which customs laws are non-effective. It is owned and governed as an immense and complicated bonded warehouse, by the State, which has permitted many manufacturing establishments to locate there in order to obtain the special shipping facilities and the free use of imported raw materials.

The Free Port territory consists of an area of 2,508 acres, of which 785 acres are under water. This territory is divided from the city proper by the Lower Harbor, the Inner Harbor, the Zoll-Canal, the Upper Harbor, and the Upper Harbor Canal.

Over 13.7 miles of stone quays encircle the various docks within and without the Free Port, these being provided with ten fixed and 631 movable cranes, to which may be added 111 other cranes located in various buildings, or attached to them.

For the temporary accommodation of goods there exist 50 sheds with a storage area of 4,090,320 square feet. Behind the sheds are railroad tracks for the prompt and convenient discharge of merchandise by land.

The most important feature of the Free Port is the system of warehouse buildings which, for purposes of administration, belong not to the

State, but to the Hamburg Free Port Warehouse Company, a corporation chartered by the State, and in which the State itself holds a large block of stock.

Upon the decision of the State of Hamburg to enter the German customs union, and at the same time to create a Free Port for the preservation of its over-sea trade, it became necessary to decide whether the necessary warehouses located within the Free Port should be under State or private control. The latter course was chosen and the North German Bank of Hamburg was authorized to establish a stock company upon March 7, 1885, under terms made and agreed upon with the financial department of the city. The buildings were erected upon public land in the Free Port, and the Company was authorized and required to issue warrants transferable to order or in the name of the bearer, for goods stored on this property. The stock capital was fixed at $2,142,000 and the tariffs to be charged for the storage and manipulation of merchandise was regulated in the contract.

The State of Hamburg placed 322,930 square feet of building ground at the disposition of the Company and undertook itself to erect the necessary quay walls and slips in exchange for a share in the net profits of the operating company. In addition to this, a portion of the net profits of the Company are set aside each year for the creation of a fund for the acquisition of the Company's stock by the State, so that eventually, upon the acquisition of all the shares in the operating company, the State itself will become full proprietor. To supply the ground space agreed upon, the 16,000 people residing upon the island of Kehrwieder Wandrahm were obliged to seek new homes.

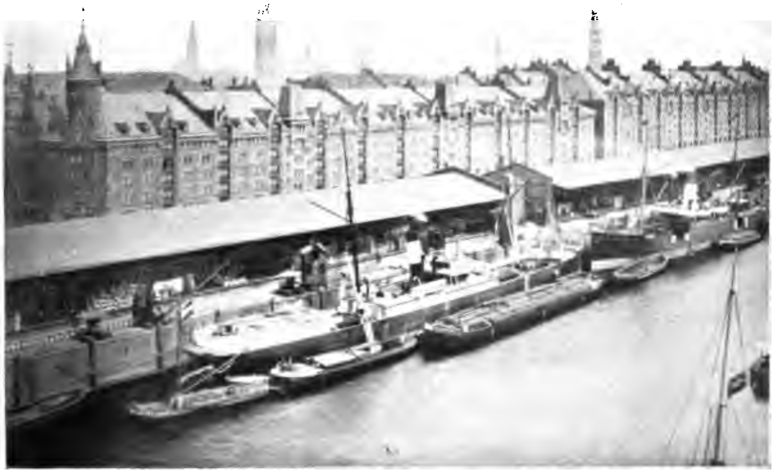
The Board of Supervising Directors consists of nine members to whom are added three persons representing the City. The managing directorate consists of two or more members of the general board.

The original warehouses have been greatly added to and improved since the opening of the Free Port to traffic. All of the buildings have a land and water front, and are divided into single fireproofed divisions which are let out to business houses of all nationalities. A great many American firms have warehouse accommodation within which, at times, millions of dollars worth of American goods are in storage, or are in processes of manipulation for re-exportation to the various markets easily accessible from Hamburg.

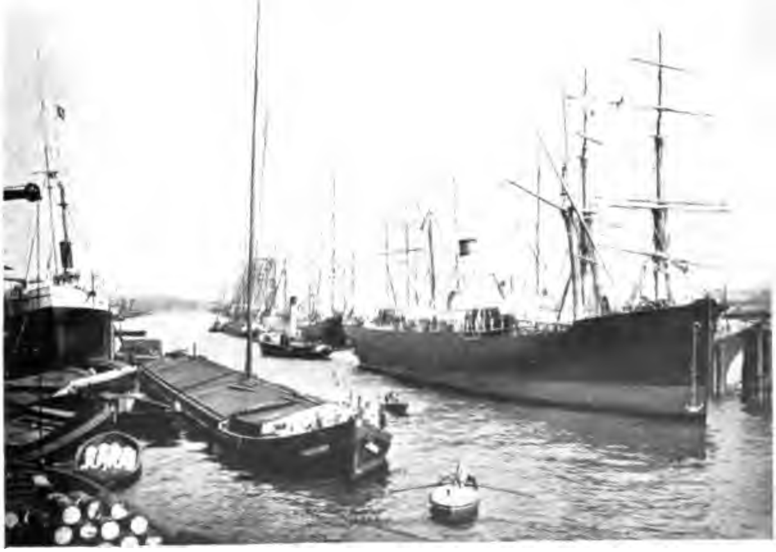
Until January 1, 1910, 1,161,069,624 square feet of land were covered by warehouse buildings, within which there were 5,417,725,716 square feet of storage accommodation. Of the total storage accommodation, 3,186,972,828 square feet were leased to particular firms, while the remaining 2,230,752,888 square feet were administered by the Company in its capacity as a storage Company.

In consequence of an advantageous development of the business, the financial result improved from year to year, as is shown by the following figures:

As rent for office and storage rooms, the following receipts were booked:



View of Sandtor Quay.



View in Harbour.

A Busy Scene in Hamburg Harbour.

View in Sailing Ship Harbour.

1889—$307,356.91
1898— 388,493.15
1908— 501,821.98

The business of the storage department of the Company developed slowly in the beginning. Of the larger mercantile firms in Hamburg, few could make up their minds to break away from the old custom of having all the necessary work performed by men in their own employ, or so-called "Quartiersleute" (small storage concerns), in warehouses of their own. However, the safety of the Company's houses, and the other favorable accommodations provided, soon received recognition. The increasing trade of Hamburg, and the demand for warrants as issued by the Company on goods stored, whether to serve as security for loans or not, has added considerably to the number of patrons and developed this department of the Company.

Merchandise on hand in the Company's own warehouses in the years mentioned amounted to:

At the end of 1889—345,624 packages
" " " " 1898— 825,116 "
" " " " 1908—1,937,617 "

among which were:

At the end of 1889—147,137 bags of coffee
" " " " 1898— 603,012 " " "
" " " " 1908—1,761,847 " " "

At the end of January, 1910, the quantity of coffee on hand amounted to 2,236,306 bags.

The gross receipts of the storage department amounted to:

$147,534.24 in 1889
274,926.61 in 1898
571,583.08 in 1908

To meet a demand, therefore, the Company took out general fire insurance policies on several of its storage houses for goods stored therein, and in consideration of average monthly premiums, placed these policies at the disposition of merchants owning such goods. This insurance amounted to $17,831,875.35.

It may be easily understood that a stock capital of $2,142,000 was not sufficient for such an immense undertaking. Consequently, in order to meet further building requirements as well as to effect the purchase of a central power station, which up to the present has only been leased by the Company from the State of Hamburg, the Company issued obligations as follows:

1. 3¼% preference loan Sept. 14, 1888, June 29, 1889,—$1,190,000.
2. 4% preference loan, Divisions I & II, April 1, 1893, Aug. 31, 1900,—$1,190,000.
3. 4% third preference loan March 5, 1902, Feb. 19, 1908,—$1,428,000.

The following dividends were paid to the shareholder from 1889—1905, 5%; 1906—1908, 5½%.

By virtue of the articles of agreement, the Hamburg State received:

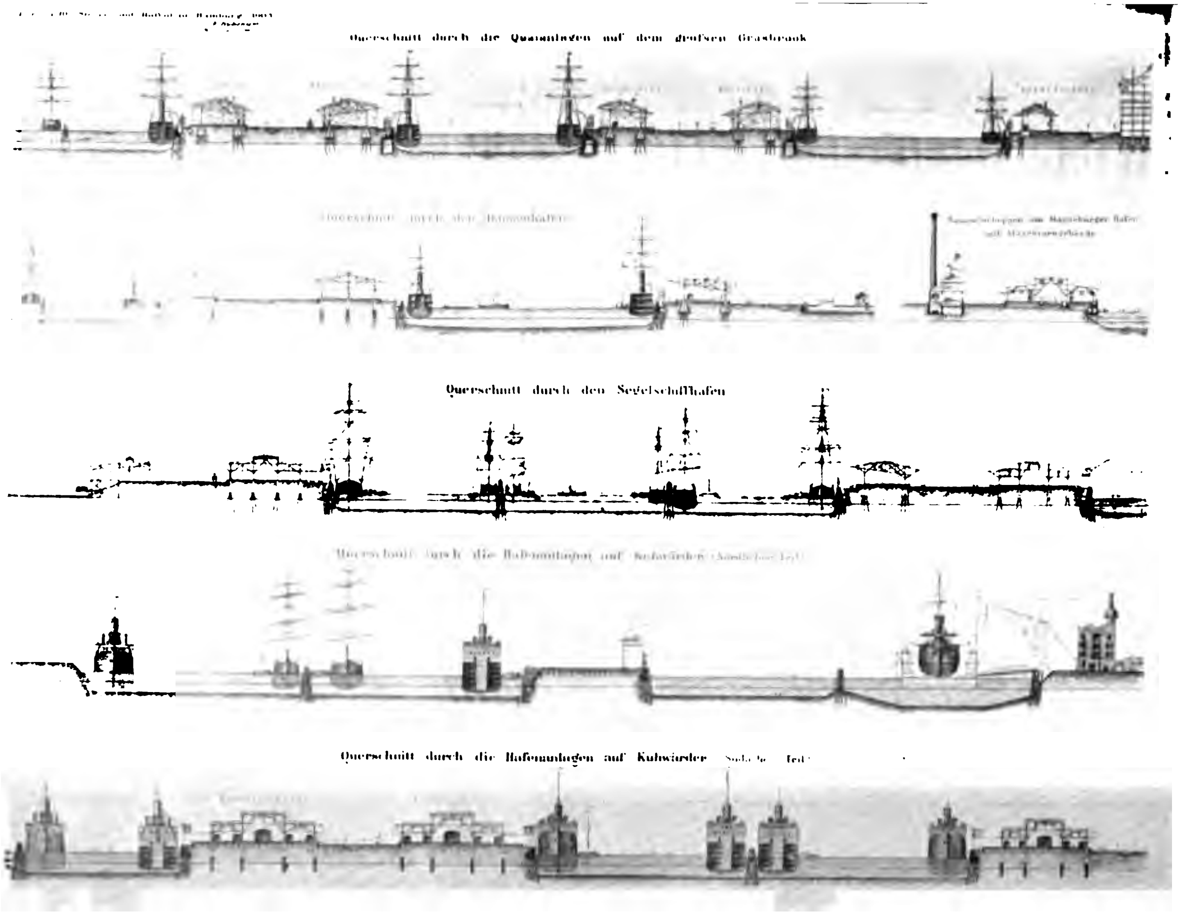
from 1889—1906 a dividend of 3½%
from 1906—1908 a dividend of 5½%

on a capital of $3,570,000 as compensation for the land area assigned to the Company at the outset; additional dividends were also paid for the creation of a fund with which to acquire shares, as set forth in the original agreement.

The steadily increasing commerce of the City has compelled the State Government to enter upon a great scheme of harbor improvement, the cost of which will be $10,733,800, if the original estimates are realized.

This public work contemplates not only more extensive facilities for receiving and despatching ocean-going vessels, but similar facilities for river craft, as the two forms of navigation are inter-dependent. The low marshy lands adjoining the present harbor have been, or will be, acquired for this purpose, and new terminal canals and harbors for river craft are being completed as rapidly as possible. A new harbor for coastwise vessels, and three parallel harbors for the largest ocean-going vessels will be added to the Free Harbor zone. Of these harbors, two will have a width of 984.25 feet, and one of 688.97 feet. Separated therefrom will be a new petroleum harbor 459.32 feet wide and about 3,280.8 feet long, to the south of which, on the land side, will be a canal created connecting with the lower Elbe. Between this canal and the third new harbor for ocean vessels will be ample area for a ship building yard. There will also be a new harbor for yachts, now much needed, and a pilot station to accommodate sixty harbor pilots, and to provide accommodations for the navigation school at Hamburg.

New quay walls are to be built in such a manner as to admit of a general dredging of the harbor throughout to a depth of 22.9 feet below normal low water. As the mean difference between high and low tide is about 6½ feet, it will be possible in the future for the largest ocean-going vessels fully loaded to reach the City, whereas, at the present time, vessels of the AMERIKA class are not ordinarily brought into port, but remain in the lower Elbe. Ships of this class can reach the


Querschnitt durch die Quaianlagen auf dem Grofsen Grasbrook
Querschnitt durch den Segelschiffhafen
Querschnitt durch die Hafenanlagen auf Kuhwärder

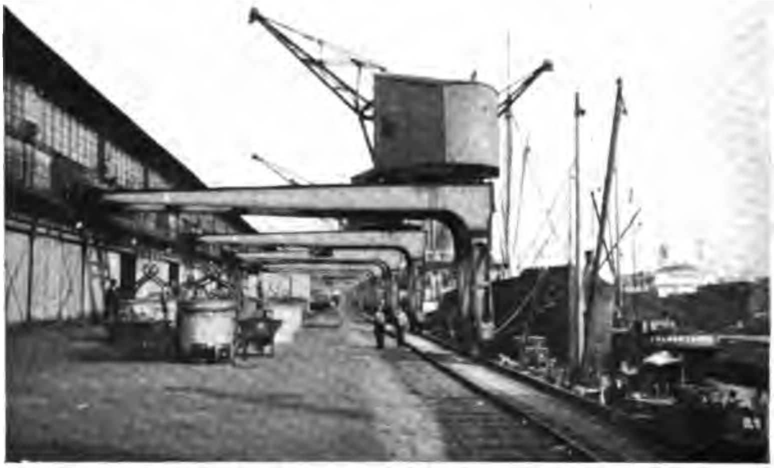
Cross-sections of Typical Hamburg Harbours.

Powerful Half-Arch Cranes of About 3 tons Capacity, and Two-Story Sheds.

Hoisting Crane Lifting About 20 Tons.

Ships from Every Clime Can be Seen in Hamburg's Harbour.

View Showing a Crowded Section of Hamburg's Harbour.



Forty-two of These Half-Arch, 3 Ton Cranes Around One Dock.

Busy Scene in Hamburg Docks.